Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLII. · NEW YORK, SATURDAY, SEPTEMBER 19, 1903. No. 12.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE Hastings House, Norfolk St., Strand, London, England.

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ELECTRICAL WORLD AND ENGINEER.

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United States, Canada or Mexico - - - - - -	per year, $3.00
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Single copies - - - - - - - - - - - - -	.10

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, SEPTEMBER 19, 1903.

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SUMMER LIGHTING LOADS.

It was a very interesting and suggestive paper for central station men that Mr. E. A. Leslie, of Brooklyn, N. Y., read before the Edison convention last week on the development of summer lighting, accompanied by a reprint of the Brooklyn Edison bulletin showing what has been done at Coney Island, the great seaside resort of New York. When we recall how slight was the summer business of the early lighting companies, because of the short hours of burning and the extent to which consumers had gone away for holidays, it is hard to realize how enormous is the business now done, thanks to power service, fan motors and the call for current at amusement resorts. We cannot refrain from quoting a passage from Mr. Leslie's suggestive paper where he says: "The most striking and significant feature lies in the fact that we require more machinery to handle our 'summer load' than is required for our preceding 'winter load,' an unusual and perhaps unique reversal of the ordinary conditions." Now, it is rather rare for a company to have the chance to supply current to a resort visited by 300,000 people on a summer day that was partly wet, but every city, as Mr. Leslie contends, has now some provision for the summer entertainment of its population, and out of this condition new sources of revenue should arise. There is even a possibility that in this respect the lighting companies might emulate the example of the street railway companies, which have established or assisted in creating no fewer than 352 pleasure parks on their lines, from which in many cases revenue is derived additional to that brought in by the car fares. It is an undeniable fact that such places as Luna Park at Coney Island are popular as much for their lighting and illumination effects as for any other reason. As Mr. Leslie remarks, in a passage which is an eloquent testimonial to the social value of electric lighting, before such spectacular effects were introduced, serving to light usefully as well as to merely amuse, most people went home from Coney Island by daylight. Now they are as ready to go at night as by day, and even greater amusement schemes have been set on foot as the result of the demonstration of what the electric light can do.

CONDITION OF THE STREET RAILWAYS.

We have already presented and reviewed in these columns the statistics of the American street railway industry as compiled by the United States Census Office. A further study of the figures, of considerable interest, is to be found in the paper read before the street railway accountants at Saratoga by Mr. W. M. Steuart, chief statistician of the United States Census Office, under whose supervision the work has been done. One striking remark made by Mr. Steuart was to the effect that during last year no dividends were paid on $667,000,000 of common and preferred stock, or not less than 50 per cent. of the total issued. Moreover, accepting the figures as published, the stock issued and the funded debt outstanding, for all roads, exceeded the cost of construction by $140,000,000. This is suggestive data, but it must be evident to anyone who considers the subject that something more than the cost of construction goes into the value of a street railway property. The franchise, of course, has a value, but we are not considering that item. There are other elements that go to the creation of a property, and many of them are rather intangible; but they are necessary to the creation and development of any enterprise. In real estate values they may constitute part of the "unearned increment," which it is often assumed

comes to the owner without any effort of his own. Such a view is largely erroneous, however, except in the case of unimproved property; while as regards a street railway it is a notorious fact that the trolley benefits real estate and other material elements in the community far beyond any value that might attach to its franchise. The record of trolley development is replete with instances of enormous benefit conferred on large masses of population by the new means of rapid transit.

In this paper Mr. Steuart offered also some valuable suggestions as to possible improvements in the standard form of accounting. These changes are apparently necessitated by the fact that very often a street railway property is no longer a simple, self-contained enterprise, but is become a complex organization, particularly in respect to owning and operating electric light plants. It would appear that an opportunity is here presented for bringing the electric light companies into line, and before the street railway accountants as a body do anything, we hope they will get into touch with the National Electric Light Association. That body has taken up the question of a standard form of accounting from time to time, but to-day the subject is as open as it ever was, and thus something could be done to harmonize with the street railway industry. Not alone, moreover, are lighting and street railway properties being worked in common, so that a form of accounts to suit both is desirable, but these two electrical interests in turn operate other plants, such as water works and ice works, and now some of them have taken up telephony. The telephone industry again is absolutely without standard methods of accounting, and it is very hard to find out just "where it is at," financially and economically. Mr. Steuart's voice is as that of one crying in the wilderness, but he renders a public service in taking up the matter, and in beginning with the Street Railway Accountants' Association, which has already done such excellent pioneer work in bringing system out of chaos.

Opportunities for Wireless.

Reading the accounts of the total interruption of wire traffic in England last week by storm and again in Florida this week, we cannot help being impressed with the splendid opportunities that exist for wireless telegraphy; and we cannot help wondering why it is not adopted, at least as an emergency safeguard, by the existing land line systems. We have reason to know that some officials of the telegraph service expect to see such a step taken at no distant date, but meantime nothing of the kind happens. Here an excellent chance to achieve distinction is meantime afforded our own United States Signal Corps, about whose use of the wireless a good deal has been heard from Alaska and other points, although specific data are lacking. The establishment of a general system under the control of the Signal Corps, linking all the military posts, would give an admirable chance for threshing out the undeniable difficulties that confront overland wireless messages. The growth of a military system covering at first comparatively short distances, and then extending to more distant posts, would result in the accumulation of most important practical data in the hands of trained observers, and would tend very strongly to make the government entirely independent not only in emergency work, but in its ordinary routine communications. And in this connection one must consider the lessons that the yacht races have taught as regards the matter of interference. Apparently the whole region around New York was reeking with etheric waves, while rival operators pounded each other with dissonant and incoherent messages. Truth to tell, it is about time for syntonic working to fish, cut bait or go ashore, as the fine old Gloucester epigram has it. If the rival wireless systems can really avoid interference with each other and live like Christians in peace and concord, it is high time that they did it. Wireless telegraphy is a most notable discovery; as an art it has a great future before it, and has certainly come to stay; but it is no easy job to discover what are its real, as distinguished from its assumed, properties. That there is much still to be learned about it is evident enough; but this fundamental matter of the syntonic working that is absolutely necessary to insure non-interference ought to be settled first of all. On the other hand, while that question is being threshed out, the Signal Corps would have a relatively easy time of it, for its work would generally be done in remote regions with interference, innocent or malicious, reduced to a minimum.

The Niagara Meeting of the American Electrochemical Society.

The American Electrochemical Society this week meets the second time at Niagara Falls within a year and a few days, thus indicating the predominant place which that locality holds in the American electrochemical industry. It may be added, however, that in view of the manner in which almost all of the electrochemical works at Niagara have, by agreement, been closed to visiting members of the Society, the attraction to that place is one more of sentiment than having an utilitarian reason. Moreover, were it not that the electrical fraternity of Niagara is happily endowed with much more than the usual spirit of hospitality—in the social sense—the wisdom of asking it within little more than twelve months to be the host for three electrical meetings might be questioned. Much has been said of the desirability of the American Institute of Electrical Engineers and the American Electrochemical Society becoming affiliate to the extent of holding, regularly or occasionally, joint meetings, and it would seem that since both organizations this year had a desire to meet at Niagara, it should not have been a particularly difficult matter to have come to an agreement as to a date for a common meeting that would have been convenient for both societies. Since the fields of the two societies overlap to a considerable extent, and since almost every subject discussed by either society has some interest to the members of both, it is to be hoped that the failure in the past in arranging joint meetings does not signify that some insuperable difficulty has been found which will continue to prevent the two bodies coming together.

The programme for the present meeting includes 16 papers, or less than the number read and discussed at the meeting of the society at Niagara Falls last September. What is lacking in number will, however, judging from the titles of the papers and the authors, probably be more than made up in quality. The two most important entries on the programme are a discussion on electrolytic copper refining, to be opened by Prof. W. D. Bancroft, and a discussion on the theory of electrolytic dissociation, to be opened also by Prof. Bancroft. In the past the theory of electrolytic dissociation has met with little respect when the subject has come before meetings of the society, and we have several times referred to the flippant manner in which it has been treated on such occasions. We hope that at Niagara the subject will receive a full and fair discussion on its merits and without a show of the prejudice which unhappily appears to have been engendered by the ill-advised manner in which some of the German exponents of the theory have denounced all those who have ventured to criticise it. Whether the theory will eventually be fully substantiated or not, the fact will remain that the discussions and the thought to which it has given rise have been of the highest value to electrochemical science; and the names of those who have become identified with its development are not of men whose opinions can be dismissed with contempt. Meantime the

Society may be congratulated upon its growth and vigor, showing that a place existed for it. All the electrical bodies are in this excellent condition, which is again a testimony to the state of the art. The expansion of the Institute has thus aroused surprise in some quarters, but obviously it could not take place without the material necessary for building up, and that material is found not alone in the prosperity of the industry, but in the existence of increasing numbers of young engineers infused with professional pride as well as with enthusiasm for the ideas and forces they are called upon to apply in the social and physical world.

STEAM VS. ELECTRICALLY DRIVEN BOILER PUMPS.

In the Digest is given an abstract of a paper read before an English society, treating of the relative economy of steam and electricity in driving the auxiliaries of electrical plants, in which comparison the electric drive naturally comes out ahead on the score of efficiency of power. What appears surprising, however, is the low figure implied for the consumption of steam by steam-driven pumps, which in an extreme case was only two or three times as great as the steam consumption at the generator corresponding to the power required by a motor driving a pump. Owing to the manner in which steam is worked in steam-driven pumps, they are notoriously wasteful, tests having shown that the quantity of water for a horse-power hour in the case of boiler pumps ranges from 100 to 150 pounds. Consequently, the ratio on the basis of the comparison made by the author should naturally appear to be as 5 or 6 to 1. However favorable such a comparison may be, it still remains a matter of doubt if boiler feed pumps should be electrically driven. Owing to their situation close to the boiler, the objection to steam-driven auxiliaries aside from their inefficiency, does not apply; in attendance they are more adapted to the care of the firemen or water tender than the electrically-driven pump; and, as pointed out by the author, when auxiliary pumps are electrically operated safety requires the use of a storage battery in connection with a plant in which all of the auxiliaries are electrically operated. Moreover, since the percentage of the power generated by the main engines which is consumed in feed pumps is very small, the saving to be effected by the substitution of the electric drive would seem to scarcely justify the additional expense and complication. With the exception of the steam pumps, however, there appears to be no reason why auxiliaries should not all be electrically driven, though in some cases the requirement of an exhaust for feed-water heating may enter.

A TEST THAT WOULD BE USEFUL.

Ever and again we find it appropriate to say a good word, generally coupled with certain admonitions, concerning our old friend the primary battery. Of late years it seems to have been lost in the shuffle, so that the regularly quarterly return of the battery with valuable chemical byproducts has failed, and even the fine old secret depolarizer has lost its potency. And yet with all its faults it has not lost our regard. It did sterling service for the telegraph and the telephone and stirred the aspirations of a generation of electricians, now for the most part gone, but whose names are written in enduring bronze. And in spite of the dynamo and the storage battery, it is quite certain that there is to-day a greater reward waiting for a really good primary battery than ever before. Besides the thousand-and-one minor domestic uses of the battery, there is an immense demand for the highest grade of service in the sparking devices of explosion engines. For automobile use alone the call for batteries is enormous, and although the best of the dry batteries now in use are by no means to be despised, they still leave much to be desired. The work in automobiles and launches is really rather severe and calls for a battery of far higher powers than are usually to be found. It is a steady pull, that sort of service, and involves rather serious consequences. And besides this there is a considerable amount of rather heavier work that would often be turned over to a primary battery if one having the right qualities were available.

First in the list of qualities desirable in a primary battery to meet modern requirements is eternal preparedness for action. No cell that requires to be set up for use or that contains a porous cup for the depolarizer is seriously to be considered, for sooner or later diffusion will get in its work. Next in importance, perhaps, is thoroughness of depolarization. Steadiness of voltage is always desirable, but it is of even greater importance that polarization, if present, shall not go beyond a certain moderate amount. If a cell will give at the start 1.5 volt it may fall to 1.25 without great detriment, provided that it will stay there. Of course, the higher the initial voltage and the steadier it remains in service, the better, other things being equal. Low internal resistance is also a property of great importance for the modern uses of batteries. Not only does it mean efficiency, but the possibility of use in many places where a high resistance cell would be inapplicable. Besides this, the modern battery must be either "dry" or sealed, so that the electrolyte may not stop, and it must be free from corrosive fumes. Finally, it must be compact in form and reasonably cheap. By the latter requirement we do not mean that it must sell for a quarter, but that the upkeep shall not be unreasonably great or the replacement cost more than a dollar or two. Of the batteries now in use, many fulfill some of the requirements admirably, but none quite well enough. The best cells of the Leclanché type come nearest to filling the bill, but they cannot be depended on to hold their voltage under heavy rates of output, particularly when made up in the "dry" form. The best of them do pretty well, but they will stand improvement. A heavy-duty Leclanché properly designed would find a better market now than ever before. If a cell could combine the readiness and cleanliness of a Leclanché with the endurance of the venerable Grove or Bunsen cell it would be very near the ideal.

Now, let us suggest that the St. Louis Exposition is near at hand, and that there is no better time or place for the exploitation of the best batteries that American ingenuity can devise. Let every manufacturer put his wits to work and bring out something a little better than has yet been put on the market. Then let all hands unite in a request not for the perfunctory tests and awards that belong to a great exposition, but for a genuine and thorough competitive battery test on the good old fighting principle of every one for himself and Devil take the hindmost. Unless we greatly mistake, such a competition would bring to light some very remarkable cells and would stimulate business to an extraordinary degree. Under such a spur a class of cells would be made far superior to those now in common use, and the consumer would be led toward the use of a better class of goods than are generally to be found on the market. There is always the chance, too, of bringing out something radically new and tremendously effective, for to win out in a test of such sort would be a prize worth the struggle. Expositions of late have lost in value to the exhibitor by keeping clear of rigorous tests and such like savage competition, and in trying to please everybody have pleased nobody. General tests are, indeed, a pretty severe proposition, but a little affair of the kind suggested would not be difficult to conduct, and the results would have no small commercial importance. The winner would be forthwith besieged by gentlemen in goggles and rubber jackets, and his factory would echo the squawking of their horns.

Tesla Split-Phase Patent Sustained.

Judge Archbold, of the United States Circuit Court for the Eastern District of Pennsylvania, has handed down a decision in a case involving the Gutmann wattmeter, which sustains the fundamental Tesla split-phase patent. The principal defense was a publication by Ferraris in 1888 on the rotary field and of the means for obtaining polyphase from single-phase currents. These disclosures were made in a paper read by Prof. Ferraris before the Royal Academy of Sciences of Turin, Italy, in March, 1888, a portion of which was published on April 22 following, in *L'Elettricita.* The Tesla patents in suit were not applied for until December 8 following, but the court held that the testimony in the case showed conclusively that Tesla had, early in May, 1888, a complete grasp of the split-phase idea; and not only is the invention beyond question carried back by it to that period, but the patent not being able to be worked out in a day, ground is thus laid for an earlier date if there is fair evidence to warrant it. The court holds there is such evidence, testimony showing that Tesla disclosed the principles of his invention at a date prior to April 22 to his patent solicitor, the date being somewhere between the 8th and the 18th of April. This evidence is supported also by the testimony of a former business associate of Mr. Tesla, who states that Tesla spoke to him of the idea in the summer or fall of 1887. The date claimed by Tesla of his discovery was September, 1887.

After reviewing at great length the testimony as to priority between Ferraris and Tesla, and deciding in favor of the latter, the court considered at equal length the question of infringement of the Tesla split-phase patent by the Gutmann meter. Its conclusion is that the construction of the meter is in effect a motor in which the armature is operated upon by two independent interconnecting circuits produced by passing through them a divided and dephased alternating current derived from a single source, this apparently realizing the patents in suit. After further consideration of the principles of the meter in suit, the court decided that the meter infringed the Tesla patent. The finding is that the patents in suit are valid and have been infringed.

An interesting portion of Judge Archbold's opinion is that in which he gives a history to date of the opinions rendered in suits involving the Tesla split-phase patents. Judge Townsend, in reviewing the fundamental patents, discussed the alleged disclosures of Siemens, 1878; Bailey, 1879; Deprez, 1889, 1884, and Bradley, 1887, and the claims advanced for them as anticipations, which he held to be unfounded, and these conclusions were affirmed on appeal. The essence of the invention was declared by Judge Townsend to be "the production of a continuously-rotating or whirling field of magnetic forces for power purposes by generating two or more displaced or differing phases of the alternating current, transmitting such phases with their independence preserved to the motor, and utilizing the displaced phases as such therein."

The same patents came up before Justice Brown and a similar result was reached. The Dumesnil (1884) and the Cabanellas (1885), two French patents, which had not been brought forward before, were particularly relied on as anticipations, but were distinguished from those in suit in a carefully-expressed and convincing opinion. These French patents, however, according to Judge Brown, established that Tesla was not the first to employ alternating currents out of phase with each other for power purposes, so that the expressions in previous cases which attributed this to him would have, as he thought, to be qualified if not recalled. But it was at the same time pointed out that in neither the Dumesnil nor the Cabanellas was there a resultant magnetic force, the distinctive feature of the Tesla invention; each of the others named providing for the independent action of separate alternating currents operating on different ends of the motor armature without any play of the magnetic and electric forces in between. "As it stands, the Cabanellas patent is unintelligible to me, but taking it as it is explained by the defendant's experts and illustrated by the exhibit in evidence (of the correctness of which, however, I have much doubt), there is nothing more at the best than a mechanical combination of the two operative devices like the opposite cranks on the same axis of a locomotive driving wheel. There is no conjoint operation as in a Tesla motor of the two energizing circuits by means of a combined magnetic influence to produce a common result. It is important, however, to observe that while in no sense anticipations, the Dumesnil and Cabanellas serve to limit the invention of Tesla—if not, indeed, so limited in his patents themselves—to a device in which a magnetic resultant of dephased alternating currents exist, the mere use of alternating currents out of phase with each other made otherwise effective being something aside and different."

The derivative patents in suit were first considered in the Dayton Fan & Motor case and affirmed, and a decision rendered in substantial accord with those which had preceded it. One defense there, as in the present suit, attempted to be made, was that it involved no inventive skill when once the practicable use of alternating currents of different phase was established, to substitute the dephased split current which was a well recognized equivalent; but it was not so held, nor could it be in the present case. This question was practically put at rest in this court by the decision of Judge McPherson in a case where two of the earliest Tesla split-phase patents were sustained. But aside from that, and upon an entirely independent consideration of it, Judge Archbold says the same conclusion must be reached.

The patents in suit were also before Judge Lacombe, and in addition to the attack made upon them in other cases, it was further urged that, in the paper read by Prof. Ferraris before the Royal Academy of Sciences, of Turin, Italy, March 18, 1888, a portion of which was published on April 22 following, at Milan, in *L'Elettricita,* a journal devoted to electrical subjects, not only was there a full disclosure of the transmission of electric power by means of alternating currents of different phase, but also the use for the same purpose of a dephased split current derived from a single source, the same as in the patents in suit. Upon a due consideration of the opposing proofs, the invention of Tesla was held to be carried back of this publication; but on appeal the decision was reversed, the evidence brought forward by the complainants not being considered sufficient for that purpose; a conclusion which was followed by Judge Colt in a case by the same plaintiffs against the Stanley Instrument Company, in the First Circuit, not yet in print. This, said Judge Archbold, in concluding his review, and the matter of infringement, are the overshadowing questions in the present case.

Discussing the contention that a meter is not a motor, and that on this ground of itself no infringement can be charged, Judge Archbold said that, as pointed out by Judge Lacombe in the Catskill case, while the Tesla patents contemplate the production of power, they are silent as to the amount of it; and as a meter armature rotates against the action of a permanent magnet and turns a spindle which operates the registering devices, the production of some power is necessarily involved. It is somewhat aside from the question, but still it is a circumstance that Gutmann himself, in accordance with whose patents the meters in question are constructed, recognizes and claims therein that this device may be used for power purposes also. No doubt the strict object of a meter of this class is to measure and record the element which passes through or actuates it, gas, water, the electric current, or whatever it may be; but where, as here, it is, in mechanical construction, nothing more than an adapted motor with meter attachments, it cannot escape infringement on the plea. Judge Archbold holds that there is nothing in conflict with this, when rightly considered, in what is said in an opinion cited relating to a water meter. The attempt there made was to defeat a special safety appliance of a water meter by references drawn from the general motor art, and it was in that connection that it was held that the two were not the same.

Fires of Electrical Origin.

The fire report of the Electrical Bureau of the National Board of Fire Underwriters, dated July 10, 1903, contains some 30 notices of fires since April 10, 1903, due to electrical causes. In one case the static electricity from a belt ignited benzine vapor, causing a loss of $189,000. No less than nine of the fires resulted from the use of flexible cord conductors, and several others from the melting of open-link fuses. Improperly-installed and unprotected lamps in show windows were the cause of several fires. With scarcely an exception none of the fires would have occurred had the installation been in accordance with the present code of underwriters' rules.

Institute Meeting.

The next meeting of the American Institute of Electrical Engineers will be held at 12 West Thirty-first Street, New York, September 23. The topic of the evening will be electro-hydraulics. The following papers will be presented: "An Efficient High-Pressure Water Power Transmission Plant," by George J. Henry, Jr., and Joseph N. Le Conte; "Electric Motors for Centrifugal Pumps and Fans," by A. J. Bowie, Jr.; "A Suggested Hydraulic Unit," by R. L. Montague.

York Haven, Pa., Transmission Plant.

THE electrical transmission plant of the York Haven Water & Power Company on the Susquehanna River, at York Haven, Pa., is approaching completion, all the outer and interior constructive work on the plant being concluded and the completion of the installation of the machinery is all that remains. By the beginning of 1904 the plant will be distributing its power throughout the counties of York and Lancaster, and much machinery that is now being operated by steam will derive its motive power from the new and cheaper source.

The project is due to Mr. Henry L. Carter, who formed the York Haven Water & Power Company, which was chartered with officers as follows: Henry L. Carter, president and manager; Judge W. F. Bay Stewart, vice-president, and Henry W. Stokes, treasurer. Mr. Thomas Green was made superintendent of construction and several thousand men were soon set to work upon the preliminary labors of the construction operations. The power house is 478 ft. long and 51 ft. wide, in which are installed 40 turbine water wheels of 600 hp each, each pair of which operate a 750-kw generator, or a total of 20 generators, together with two turbines, of 250 hp, each with generators for excitation.

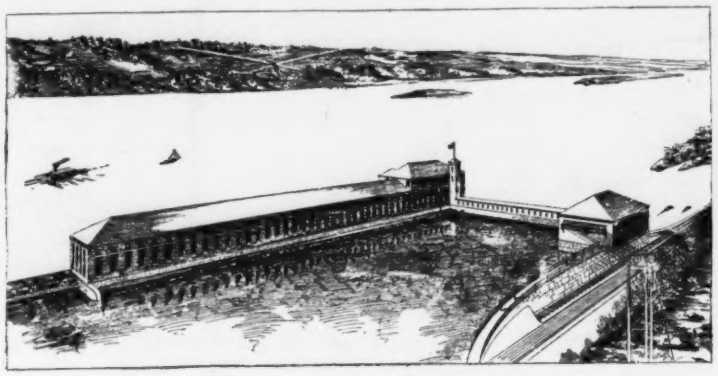


FIG. 1.—THE YORK HAVEN POWER HOUSE.

Extending from the building to the falls is an immense granite wall 3,500 ft. long and from 28 to 34 ft. high. It is 6 ft. at the top and from 16 to 20 ft. at the bottom. The wall encloses a race 500 ft. in width and 16 ft. in depth. To construct this it required 100,000 cubic yards of masonry. At the intersection of the wall is a large crib dam, 30 x 20 ft. wide, varying in height from 18 to 7 ft., and 3,000 ft. long. It is built diagonally across a portion of the falls.

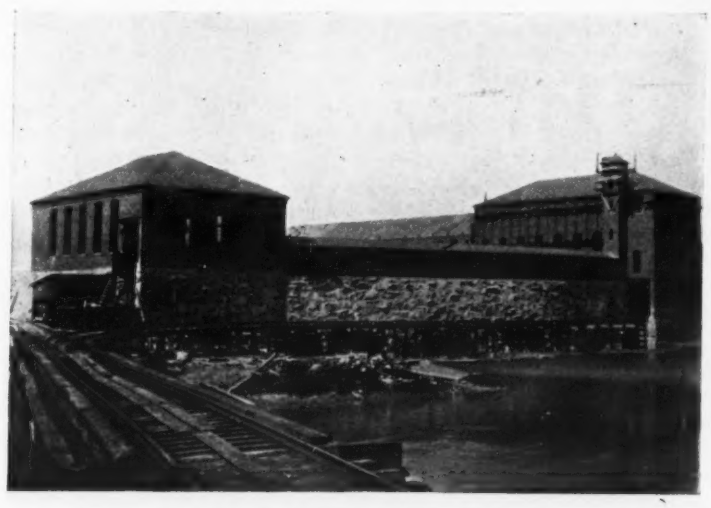


FIG. 2.—END VIEW OF POWER HOUSE, YORK HAVEN.

The dam is constructed of heavy timber and ballasted with stone. The timbers are anchored to the bed rock of the river by heavy anchor bolts. The purpose of the dam is to raise the natural head of the water to a greater fall.

To insure a durable foundation for the power house and its massive machinery blasting and excavating below the surface had to be resorted to, and a firm mass of rock far below the banks of the river was reached, and a large structure now rests on this natural foundation. To construct the building it was necessary to build a coffer-dam, the dimensions of which are 500 x 240 ft.; 45,000 bags of sand, 250,000 ft. of timber and 10,000 cubic yards of stone were used for the purpose. To provide against interruptions to the work by high water a pumping station to draw off the leakage was established. Twelve derricks, extensive hoisting apparatus and portable railways were also necessary to facilitate the work.

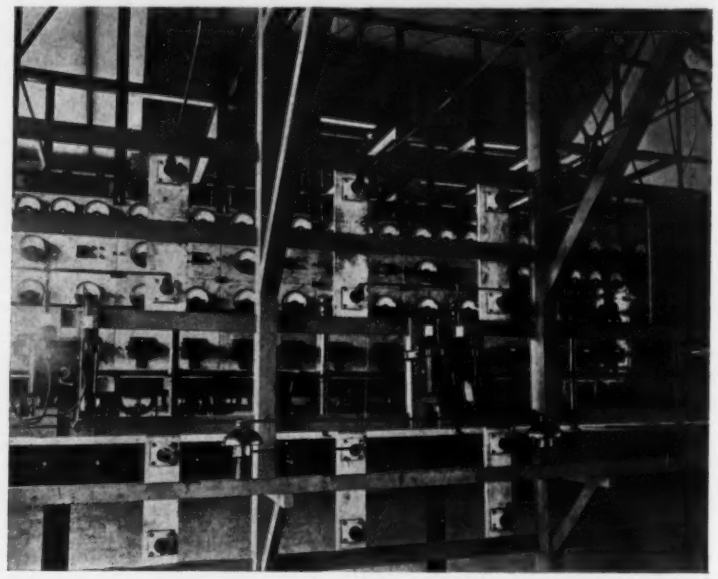


FIG. 3.—MAIN DISTRIBUTING BOARD, YORK SUB-STATION.

An operation not less important than those described was the installation of the electrical and water power machinery to be used in generating and controlling the 20,000 hp to be generated. The work of installing the machinery is in charge of Mr. T. A. W. Shock, who for twelve years was an electrical engineer on the Pacific coast, where he was identified with the pioneer Sacramento transmission plant and other important engineering work on the slope. He has installed all the electrical apparatus, both at the power house, at York Haven, and at the step-down station. Mr. Shock will continue in the service of the company in the capacity of its electrical engineer.

The generating station at York Haven is built for twenty 750-kw, 2,400-volt, 60-cycle alternating-current generators. Each generator

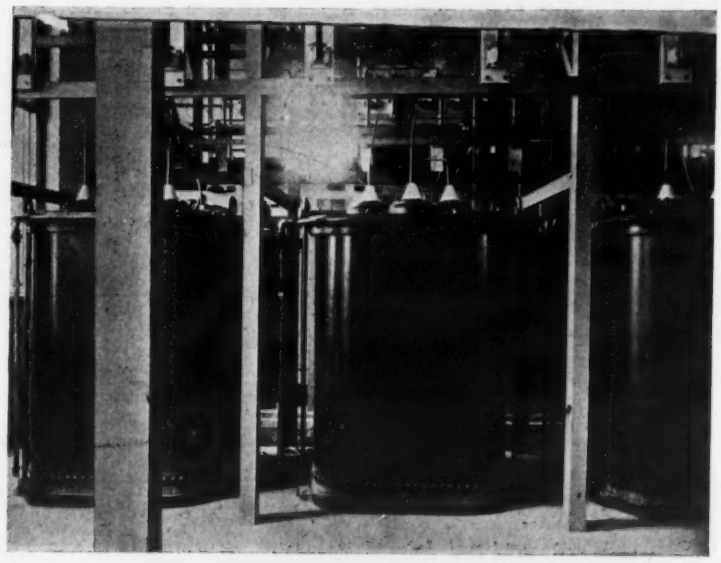


FIG. 4.—OIL WATER-COOL TRANSFORMERS, YORK SUB-STATION.

is operated by two 79-in. turbine wheels. There are also two 230-kw exciters, each operated by 62½-in. turbine wheels. These exciters have each sufficient capacity to excite the fields of the twenty generators. Six generators are to be installed this fall. All this apparatus is placed on the main floor of the building. At the south end of the building is a second story, which extends about 70 ft. north, on which are situated switchboards for the individual generators, and upon which are located all the electrical instruments for measuring the output of each machine, and also the total output of

the station. From this point the switchboard operator will control all the generators and water wheel governors on the main floor. The power is conducted from the main station through a wire alley to the transformer house by means of twenty-four 1,000,000-circular-mil cables.

In the transformer house, or step-up station, at York Haven, are situated twelve 1,400-kw transformers, with all the necessary light-

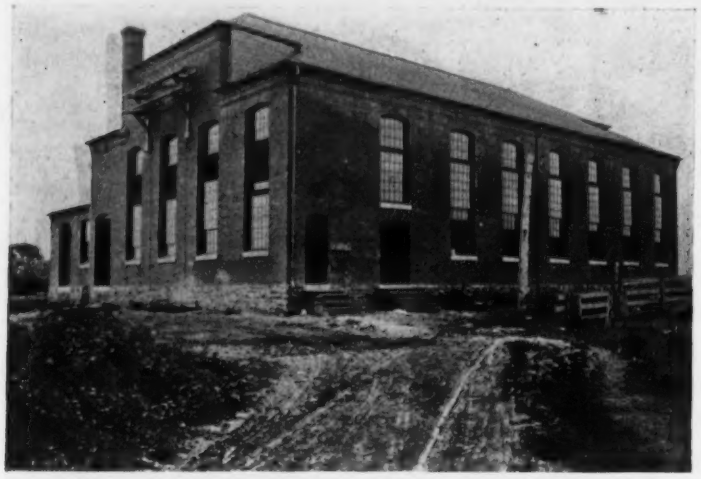


FIG. 5.—EXTERIOR VIEW OF SUB-STATION AT YORK.

ning arresters, switches and indicating devices for controlling the apparatus therein installed. The secondary voltage of the transformers is 2,400 volts and the primary voltage is 24,000 volts.

The current is conducted from the transformer house, at York Haven to York, Pa., at 24,000 volts, through distributing switches located near the entrance of the building, by means of two distinct three-phase circuits. Each circuit will transmit 5,000 hp, thereby giving a combined capacity of the pole line of 10,000 hp. Each pole is set 6 ft. in the ground, 40 ft. in length and 8 in. at the top. The top cross arm is 4 in. x 5 in., 12 ft. long, and the lower cross arm is 4 in. x 5 in., 9 ft. long. All the cross arms are well braced with angle braces and all corners are well guyed and anchored. Where the line changes direction, double cross arms and double pins are used, so that the possibility of trouble is reduced to a minimum.

At the York sub-station current passes at the entrance of the building, through high-tension, oil circuit-breaker switches, and through line-distributing busses. There it is conducted to lightning arrester banks and thence to transformer busses, and to 6 transformers of 800-kw capacity each, where it is transformed down from 24,000 volts to 2,400 volts for distribution. From the secondary side of the transformers, the current is conducted through oil transformer

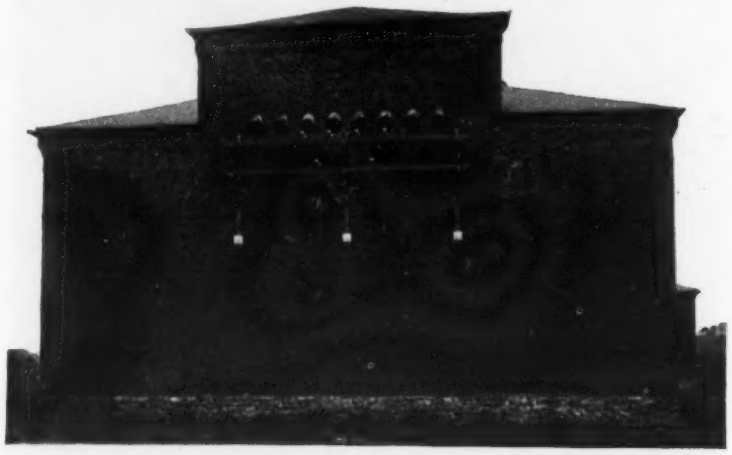


FIG. 6.—METHOD OF CARRYING HIGH-TENSION WIRES INTO YORK SUB-STATION.

switches to the main distributing switchboard by means of bus-bars located in ducts under the floor and underneath the switchboard gallery.

The distributing switchboard is divided into 5 feeder panels, 2 totaling panels, giving the total output of the sub-station, and one lighting panel for lighting the building. Each feeder is equipped with two three-pole oil circuit-breaker switches and each connected with its own bus-bars. Each panel is also equipped with all the necessary voltmeters, ammeters and wattmeters for the purpose of recording the output of each panel. The totaling panels are equipped with the necessary ammeters, voltmeters and wattmeters for recording the total output of the sub-station.

From the switchboard current is conducted through lightning arrester banks to the main distributing line. The transformers, both

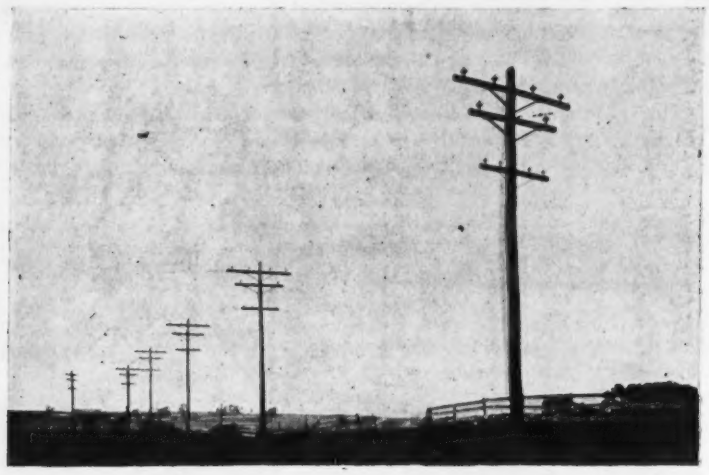


FIG. 7.—VIEW ALONG MAIN LINE BETWEEN YORK HAVEN AND YORK.

for the transformer house and sub-station, are of the oil water-cooled type.

The Stanley Electric Manufacturing Company, of Pittsfield, Mass., furnished the complete equipment of the plant and its system, the turbine wheels being of the Poole Engineering & Machine Company's make.

By duplicating everything in the way of equipment from the generators through to the distributing side of the switchboard in the sub-station, it will be possible to give double service, if such is needed. Over half of the 20,000 hp which the plant will distribute has been contracted for by mills and factories located in York.

Power will be supplied for operating the local electric light plant, so that the city of York will be indirectly lighted by the power plant on the Susquehanna River. It is stated that capitalists from Pittsburg, New York and Philadelphia have already secured sites at York Haven for new manufactories, while other towns near by are attracting industrial promoters.

Kelvin on Radium.

A special dispatch from London of September 12 to a New York daily newspaper says: "What Prof. C. V. Boys termed 'the miracle of radium' has naturally received much attention in scientific circles. At the meeting of the science branch of the British Association Lord Kelvin, in a paper which he read, made an interesting suggestion in connection with its perpetual emission of heat at, according to M. Curie's calculation, a rate of about 90 Centigrade calorics per gram per hour. He said that if the emission of heat at this rate went on for 10,000 hours there would be as much heat as would raise the temperature of 900,000 grams of water 1° C. It seemed utterly impossible to Lord Kelvin that this would come from the store of energy lost out of a gram of radium in 10,000 hours. It seemed, therefore, absolutely certain that the energy must somehow be supplied from without. He suggested that ethereal waves might in some way supply energy to radium, while it was emitting heat to matter around it. Lord Kelvin illustrated his theory by the following comparison: Suppose a piece of white and a piece of black cloth, hermetically sealed in similar glass cases, were submerged in similar glass vessels of water and exposed to the sun. The water in the vessel containing the black cloth would be kept very sensibly warmer than that containing the white cloth. Here the thermal energy was communicated to the black cloth by waves of sunlight and was given out as thermometric heat to the water in the glass around it. Thus through the water there was actually an energy traveling inward in virtue of the waves of light and outward through the same space in virtue of thermal conduction. Lord Kelvin suggested that experiments be made comparing the heat emission from radium wholly surrounded with thick lead with that found in the surroundings heretofore used."

The Electric Drive as Applied to Machine Tools, with Special Reference to Railroad Shops.

BY C. H. HINES.

Much has been written upon the above subject during the past two or three years, and it would seem as though the ground had been most thoroughly covered. But withal, there is such a wide diversity of opinion on the subject, both as to the merits of different systems, economics, current to employ, load factors and other details; and the data given of the performance of tools so equipped vary so greatly in each article that has been written on the subject, that the firm or company looking over the field with a view to so equipping their shops may well be puzzled, and hesitate as to what to adopt, or how to figure on cost, when so many "Doctors" disagree. The consulting engineer is now called upon; but in many cases he also may be in doubt. The subject is so new and the recent developments in air hardening steel so rapid, that but few engineers unless specialists in this particular line, have had the necessary practical experience on the subject, and their reports are rather apt to be based on what they have read or observed in some of the plants so equipped.

Once in the market both buyer and engineer are flooded with data, pamphlets and arguments from the advocates of the respective systems that are in use, each with the most specious arguments as to the superiority of the system that he advocates. By the time all arguments have been sifted, the party interested is still at a loss to know what is *best*. The advocate of the multi-voltage system says "a motor for every tool for economy and increased production," and states the large number of varying speeds his system permits. He also shows that the expensive first cost is compensated for by the increased production of the finished material. The three-wire, two-voltage advocate now comes in and presents the same argument, but offers a system at much less initial cost and a little less speed range; and lastly comes the alternating-current man, who recommends small groups driven by constant-speed induction motors.

All of the above systems have their respective merits no doubt, and I do not propose to go into details concerning them, as there has been much written about them for the trade, and papers have been presented before the different societies by those who are far better informed on the subject than I am. What I propose to consider here is what is best suited to the requirements of the average railroad shop with a large proportion of old tools, that proposes to change to the electric drive system.

If a shop is to be built new throughout, and is to be provided with a complete outfit of new machine tools, and if the work to be done is of a varied character so that the character of the output changes constantly, then there is in my mind no doubt of the superiority of the individual motor, with varying speeds. If, on the contrary, the shop to be changed consists largely of old tools, but too serviceable to be "scrapped," and the work to be done is practically of the same nature, year in and year out, as is the case in railroad shops, then it becomes a question of whether it would pay to attach individual motors to old machines, most of them unfitted for modern high-speed steels, or to arrange the tools in small groups adapted to the class of work which they are called upon to perform, or in other words, to adapt the work to the tool, providing such speed changes as might be necessary by mechanical means. As an example, a wheel lathe does practically the same class of work at the same speed the year through, and the limit of speed is soon determined. Now it would be folly to attach to such a tool a variable-speed motor with its high initial cost simply to provide for an occasional "hard spot" or unusually hard pair of tires, for cone pulleys would take care of such rare cases.

By judicious grouping the constant-speed induction motor is indicated for the majority of such cases. Its simplicity and absence of commutator render it practically "fool proof"—a most desirable feature—while the low cost of maintenance is also in its favor. It will do its work faithfully year in and year out, with a minimum of attention. Some of the largest railroad shops in the country are being thus equipped.

There seems to be at the present time a tendency to rush to extremes in the matter of the individual drive, and in the course of a few years, when the smoke of battle has cleared somewhat and the results and tests of time have become apparent, it will then be seen more clearly whether the results obtained have in many cases justified the enormous initial outlay that is attached to the multi-speed individual motor.

I have now endeavored to answer the question as to the system best to use in these cases, and the next question that presents itself is, what percentage of load factor must be allowed, this in turn depending largely on the total amount of power to be supplied and the grouping. There is a large amount of data in print giving the estimated horse-power of different machine tools, but this data varies so widely, with different conditions that when one is confronted with the problem of estimating the horse-power required for a shop in which a large percentage of the tools are old ones, the best method to pursue is to make a test of as many typical tools as may be required.

This is very easily and simply done. During the past two months I have made an exhaustive test of iron and wood-working machine tools for the equipping of a large railroad shop, and it was done with little trouble, with no interference with the work. A small generator and balancer was secured and located centrally in the shop to be tested, taking power from the countershaft; a small motor and controller was mounted on a substantial truck provided with four small strong iron wheels. This was readily shifted from tool to tool, and belted either direct to the tool or to the counter, the wheels blocked and the machine then worked up to the limit at different speeds and cuts. The capacity of the tool and its maximum horse-power were quickly determined. Of course, the tests may be elaborated as desired. This method is the only accurate way of determining horse-power in such a shop as I have described, and the small cost of the test is repaid a hundredfold. I obtained by the above method a collection of the most interesting data, which I hope to publish at some future time.

Having by this means ascertained the aggregate horse-power of the tools, the next question is what percentage of this shall be taken as a load factor for the power station. In this as in the question of power data authorities differ, some going as low as 20 per cent. in the case of the individual motor drive, where the aggregate power of the tools is large. But in the case of grouping such as I have described, a factor of 40 per cent to 50 per cent. is a much more conservative estimate and will be found by actual test to more closely approximate the actual working conditions, and be the safest factor upon which to figure the copper required.

In deciding upon the sizes of motors to be provided for the different tools, care must be taken in the case of the induction motor that the question of power factor is considered, as if the motors are much too large for the work they are to do, the station will have a large factor of wattless current to deal with.

Of course, in such a shop as I have described it will be necessary perhaps to have a small amount of direct current for cranes and there will be perhaps a few large tools that it may pay to equip with individual variable-speed motors, although in view of the recent developments of the induction motor for crane service even this may be done away with and alternating current used throughout. If, however, direct current is preferred for this small proportion of the entire load, it can be easily taken care of by a rotary transformer or a motor-generator set, depending upon the frequency that is used. If the frequency is low, say 25, then my preference is for the converter; but if the frequency is 60 or higher, then the motor-generator set is the more reliable.

The motors and systems to be employed having been decided upon, the next question is the copper for the mains and the best method of installing the same. In many of the railroad shops there are tunnels for carrying the steam, air and other pipes, and these tunnels have been utilized also for the electrical mains. This is possibly a good method, although the question of the dryness of the tunnel and the possible dangers to the workmen in case of failure of the insulation, must be considered; and as most shops are grouped close together, it would seem that an overhead roof-to-roof bare copper construction would answer all purposes and be far cheaper. So-called "weather-proof" wire for overhead construction is at the best but a "bluff" to the public, except in crowded streets, where it may serve to keep telephone and telegraph wires from short-circuiting the power leads; but in such an installation as I have described it is useless, and the extra expense of the so-called insulation may better be applied to substantial supports for the power lines.

I have in this article briefly outlined what has been decided upon for the equipment of one of the largest railroad shops in the country, after a most careful review of all systems and methods. I hope at some future day to be able to give a detailed description of the plant and tests, and in the meantime trust that these few ideas may prove of service to others who are called upon to meet similar problems.

Fessenden's Work in Wireless Telegraphy.

By A. Frederick Collins.

In the Electrical World and Engineer of August 23, 1903, I described the salient features of Prof. Fessenden's new system of wireless telegraphy, the text being taken from a large number of patents which had just been issued to him. Recently I have had an opportunity to examine the practical details of the new system, and to obtain besides a statement from Prof. Fessenden relating to the development of his "sliding half wave" theory, which was laid before the American Institute of Electrical Engineers in 1899.

FIG. 1.—DIAGRAM OF RECEIVER.

In taking up the subject of wireless telegraphy, Prof. Fessenden devised means whereby the intensity of the effects at a receiving station might be quantitatively measured and also means for measuring the strength of the oscillations at the sending station. With this apparatus a large number of measurements were made of the energy required to operate a coherer, and it was found that from one to four ergs were required to produce an indication with the most sensitive form of coherer then in existence. As a telephone will produce an indication with an expenditure of .000001 of an erg it became evident that the commonly-expressed opinion that the coherer was an instrument of marvelous sensitiveness was entirely wrong. A number of experiments were made to develop new forms of receivers and receivers were finally evolved, which produced an indication with a fraction of a per cent of that required to operate a coherer. The nature of the phenomena was thoroughly investigated. The length of the waves and of their harmonics was measured by placing a quantitative receiver in the vertical wire and generating electromagnetic waves by an oscillating system placed about a mile away whose capacity to earth and whose inductance for rapidly oscillating currents could be accurately determined. Then by varying the inductance and plotting the intensity of the indications received the various resonance points and the wave length of the vertical wire was determined.

In plotting the course of the waves three pieces of apparatus were employed. First a vertical wire with a quantitative receiver. This on being moved about in a lateral direction gave one co-ordinate. Secondly, a bundle of fine iron wires surrounded by a few turns of wire in the circuit of which the quantitative receiver was placed on being moved in a vertical direction giving a second co-ordinate. On immersing the receiver in the earth or water the depth to which the waves penetrate, may be ascertained. A third piece of apparatus consisting of two large copper triangles placed apex to apex with the quantitative receiver between their apexes, the bases of the triangles being grounded. This enabled the presence or absence of currents in the surface of the earth or water to be observed.

A transmitting station was placed on a boat on one side of an island, and about 100 yards from shore on the other side of the island was a receiving station set on a small wharf running about 50 yards into the water.

By the use of these three sets of instruments the course of the wave was traced from the boat to the station. It was found that the waves traveled along the surface of the water until they reached the shore of the island, the intensity falling off as the square of the distance after the first few wave lengths, and that the height of the waves increases directly with the distance. No currents were generated in the water or earth in the direction of propagation of the waves. On reaching the shore the waves were found to climb the bank which was about 50 ft. high, and at the point where the direction of the waves changed from along the water to up the slope of the bank currents were generated. Midway up the bank the current disappeared again, but reappeared once more at the top of the bank, where the direction of the waves changed again, but when the waves struck the level surface of the earth the currents disappeared once more. It is thus ascertained that currents are only generated in the earth at the point where the direction of the waves were changed. The course of the waves was then traced with similar results across the island, which was almost free from trees, down the opposite bank and out to the station on the wharf. Obviously the height of the waves was not measured throughout the full distance, as this would have required some means of reaching up into the air to a considerable distance, but the other dimensions were accurately taken.

By these experiments, in conjunction with those by which the wave lengths were determined, the fact was absolutely established that the theory given in the transactions of the American Institute of Electrical Engineers, December, 1899, was absolutely correct. In particular the much-disputed question as to whether the waves were accompanied by earth currents was definitely settled.

With the aid of the data thus obtained, Fessenden devised an entirely new system of wireless telegraphy. It differs so widely from the systems used previously, that it may be considered of a different class. The characteristics are as follows:

1. The use of a conductor at the sending station not only grounded, but provided with a conducting surface for at least a distance of one-quarter wave length. 2. The use of a closed auxiliary circuit at the sending end for prolonging the oscillations. 3. The method of signaling by throwing in and out of tune instead of by stopping and starting the oscillations. 4. The use of multiple antennæ, and verticals of large capacity evenly distributed. 5. The practically continuous generation of electromagnetic waves. 6. The method of obtaining electrical radiations of any desired frequency from a continuous current without the use of an interrupter. 7. The method of producing electrical waves in groups having a definite group frequency, whether the group frequency is the same as the discharge frequency or independent of it. 8. The method of obtaining constant capacity and inductance by the use of metallic masts and guys surrounded by choking coils so as to prevent absorption of energy. 9. The use of the "wave chute" for leading the waves out of cities or over obstructions. 10. The use of a medium surrounding the vertical conductor for obtaining the same effects with a vertical as with a large conductor.

At the receiving station the fundamental differences between Prof. Fessenden's and the older systems are:

1. The use of a current operated constantly receptive receiver instead of the voltage operated coherer. Not only is the current operated system receiver many times more sensitive than any coherer, but in addition it is only by its use that sharp tuning can be accomplished. With current operated receivers a resonant rise in effect of 400 per cent. has been obtained, while the best results given by experimenters who have worked with the coherer give resonant rises of less than 10 per cent. In the paper published by Count Arco recently the resonant rise is given as 2½.

2. By the use of a cumulatively acting receiver. This means that all the energy received is utilized in producing indications. In this

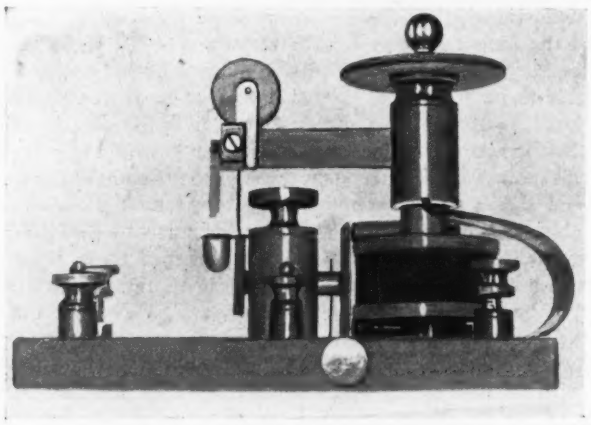


FIG. 2.—LIQUID BARRETTER.

respect it differs fundamentally from other receivers, in which the indication is proportional to the maximum intensity instead of being as in the case of the cumulatively acting receiver, proportional to the integral value.

3. The use of a closed tuned circuit instead of an open tuned circuit, which permits of much better resonance being obtained than with an open tuned circuit.

4. The use of a receiving device tuned not only to the wave frequency but also to the group frequency of the discharges.

It is evident that selection can never be accomplished by tuning, since in tuning a resonant rise of more than 100 cannot be calculated on. The amount of resonant rise is dependent upon the dampening coefficient of the resonant circuit, and since it is practically im-

possible to get a circuit the losses of which do not amount to an appreciable fraction of one per cent., it is evident that this value cannot be greatly exceeded under ordinary conditions. Hence, if *A* is within one-quarter of a mile of the second station *B*, and *B* is telegraphing to a third station *C*, 100 miles away, *B* and *C* being in tune, but *A* out of tune, then *A* will receive 160,000 times as much energy as *B* will, and the resonant is 100 times the non-resonant value, the effect on the receiver of station *A* will still be 1,600 times greater than that necessary to produce a signal. This calculation exposes the absurdity of attempting to work wireless telegraphy by wave tuning alone. By group tuning in addition to wave tuning the effect can be still further cut down one-hundredth of this, reducing the effect of *B* to the same as that of a distant station, and as the ear itself is a selective organ it is possible to obtain very good actual working results.

5. The employment of means whereby a station may not only be receiving messages from another station a thousand miles away, while another station is working within a few yards, but also whereby messages may be sent from a station, while messages are being simultaneously received from another station.

6. Means for indicating to any station whether the station to which it is desired to speak is sending, receiving or free, and whether it has gotten out of tune or not.

7. Means for telephoning messages instead of telegraphing, based on the throwing in and out of tune of the sending station by means of a telephone transmitter.

As will be seen from the above the system worked out by Prof. Fessenden differs entirely from the coherer system used by other experimenters, although some of the devices mentioned above, for instance, one form of the current operated constantly receptive receiver, being one in which the receiver depends on magnetic action and the auxiliary circuit for prolonging the oscillations and the capacity aerial have been lately used in connection with other systems. It may be mentioned here that the closed circuit for prolonging the oscillations has been attributed to Prof. Braun by Dr. Fleming, but there is no evidence or publication to show that Prof. Braun used, or described, this until some years after Prof. Fessenden's application was filed.

The most important of another budget of patents recently issued to Prof. Fessenden is one covering a modification of the hot-wire instrument called by the inventor a "barretter," from the old French word "barretor," "exchanger," from its property of exchanging a given amount of high frequency energy for continuous current energy, the latter form being easier to manage.

In the new form a very small column of liquid is substituted for the small platinum wire used originally. Various forms are used, for example, a diaphragm with a minute hole in it connected to a body of liquid, or a minute wire immersed in the liquid so as to concentrate the resistance of the liquid in the neighborhood of the point. Fig. 1 shows one form of this receiver in diagram.

The liquid barretter has a number of advantages over the platinum wire barretter, the most important being the fact that it is impossible to burn it out on account of the fact that the liquid vaporizes in case of a very heavy discharge. For this reason, as seen in the illustration of the complete set, it is not necessary to protect it against atmospheric disturbances or to enclose it in a metallic box, as a strong spark may pass within a few inches of it without injuring it or throwing it out of adjustment. Fig. 2 is a half-tone reproduction of the barretter.

A second advantage is the fact that its sensitiveness is much greater than that of the hot-wire barretter, and hence also greater than that of the Solari coherer, since the temperature coefficient of liquids is very much greater than that of metals. In the case of the liquid the same amount of energy which would produce a change of one-quarter of one per cent. in the resistance of a wire barretter, produces a change of 12 per cent. in the resistance of the liquid barretter.

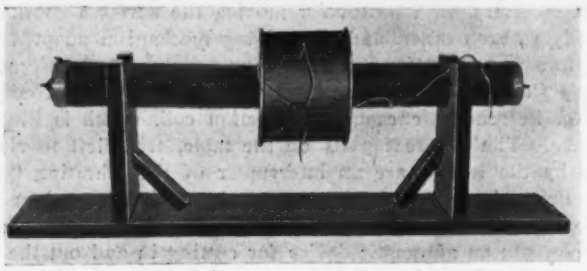


FIG. 4.—INDUCTION COIL.

It is to be noticed that the action of the waves decreases the resistance of the liquid barretter on account of the fact that the temperature coefficient of liquids is generally negative. This fact, i. e., that the resistance decreases instead of increases further adds to the efficiency of the receiver. It gives sufficient change to permit its use with a syphon recorder.

By means of receivers of the current actuated type (which may be called "current" kumascopes in distinction to "voltage" kumascopes, such as the coherer) very much sharper resonance is obtained than is possible with the coherer. A resonance curve has been obtained with a barretter in a circuit having a capacity .000279 microfarad, inductance .039 millihenry, in which the resonant rise is almost exactly 100 times the effect outside the point of resonance. It is believed that this degree of resonance has never been obtained heretofore. The distinctive feature of these devices is that they are used below the critical resistance, while coherers and similar devices must be used above the critical resistance.

Another patent covers a method of generating electromagnetic waves and splitting them up to groups periodically and arranging them independent of the discharge frequency. (Fig. 2.) Thus a double selectivity is accomplished; i. e., the receiving circuits are tuned to the wave frequency and also to the group frequency so that interference is impossible unless both the wave frequency and the group frequency of the interfering waves have the right values. This method is of considerable importance because the number of tunes is necessarily limited, while by tuning to the wave frequency and to the group frequency the number of combinations possible is meas-

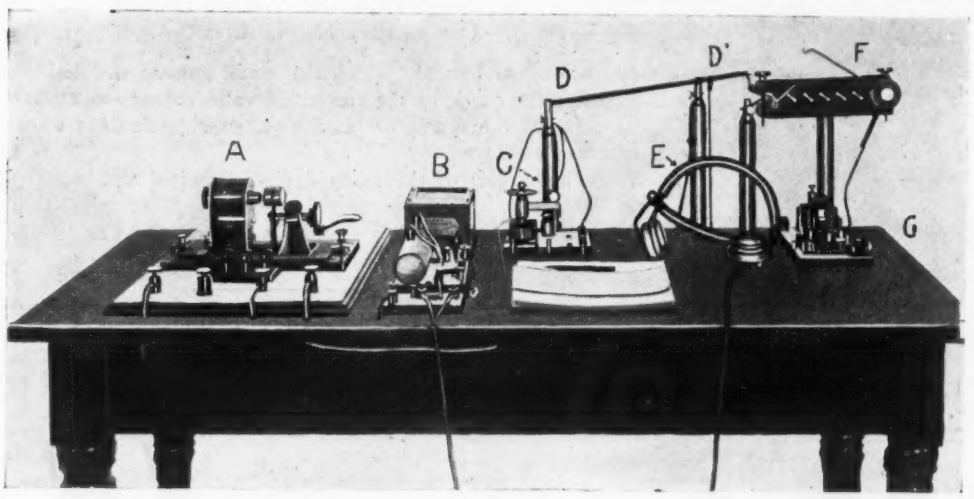


FIG. 3.—COMPLETE SENDING AND RECEIVING APPARATUS.

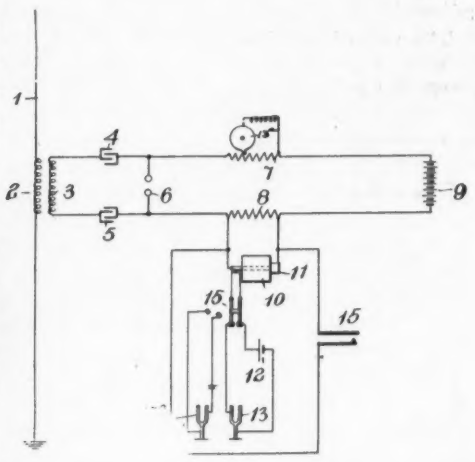


FIG. 5.—ELECTRO-MECHANICAL SYSTEM.

sured by millions. Another patent is of the same general character, but covers tuning to group frequencies broadly whether identical with the discharge frequency or not. It also covers tuning to the group frequency electrically or mechanically.

Two other patents cover apparatus and method for sending and receiving simultaneously, and a third covers the combination of a carbon coherer and a step-down transformer.

The final patent covers an improvement in the class of imperfect contact receivers, with means for moving the surfaces continuously relatively to each other, and a receiving mechanism adapted to respond to a particular frequency.

Fig. 3 shows a complete sending and receiving system employed by Prof. Fessenden, except the induction coil, which is illustrated in Fig. 4. The different parts on the table, from left to right, as shown by the letters, are an interrupter of the vibrating type *A;* Prof. Fessenden's improved system of generating and receiving electromagnetic waves (this latter device is shown diagrammatically in Fig. 5); an automatic device for cutting in and out the transmitter, *C;* a pair of head telephone receivers *D;* a multiple spark-gap *E,* and a telegraph key *F.* The object of the invention shown at *B,* Fig. 3, and in Fig. 5, as stated in the patent specification, is to provide for the generation at the sending station in varying order of two or more series of waves, each of the series differing from the other series, the selective reception and transformation and utilization of the different series and finally the recording at each receiving station of only such series of waves or impulses as are sent in a particular order.

In practice a series of two or more vertical wires for sending out the waves *5a 5b,* etc., are connected at the sending station, *A,* to a series of two or more terminals or knobs, *4a, 4b,* etc., of a series of two or more induction coils connected as usual with the spark-gap balls and also to ground.

The inductors of the coils are connected in circuits, including a source of electromotive force 2, and each circuit also includes make-and-break mechanism, all of which has been fully described by Prof. Fessenden in a patent dated August 12, 1902. The make-and-break device consists of metal discs, *3a, 3b,* etc., held in position on the shaft 20, which is rotated at a constant speed by a motor *20a.* The shaft is connected electrically to one pole of the generator 2, and the disks *3a 3b,* are also in electrical contact with the shaft; these are provided with shoulders 22, arranged to make connection with the plates *23a 23b,* etc., and are connected to the opposite pole of the generator 2; by rotating the shaft the circuits of the generator 2 may be made and broken in any pre-arranged order, since the disks are adjustably held in position for an interval of time.

The rate of rotation must bear a fixed ratio to the rate of move-

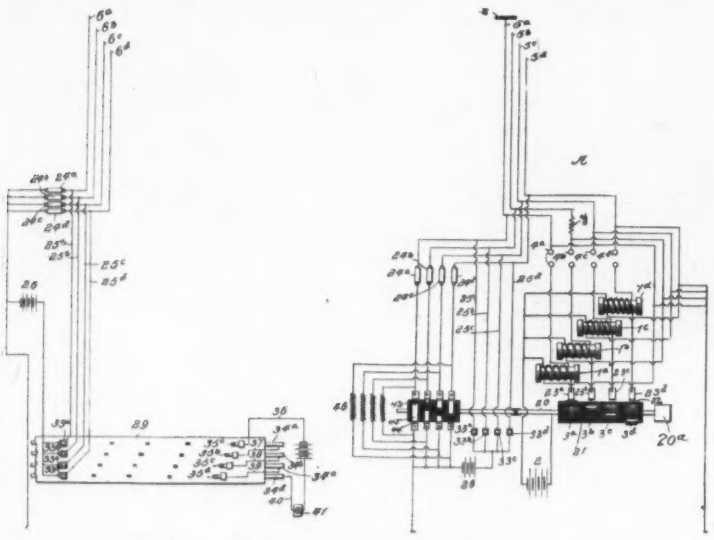


FIG. 6.—ELECTRO-MAGNETIC WAVE GENERATOR.

ment of the tape at the receiving station. The periodicity of the electric waves is dependent upon the $\sqrt{\text{inductance}} \times \sqrt{\text{capacity}}$, and as inductance and capacity vary with the length and the diameter of the wires, the latter are so proportioned relative to each other that the periodicity of the waves emitted by one wire will be different from the waves produced by the other wires. By adjusting the disks *3a 3b,* etc., on the shaft the series of waves may be sent out in any desired order.

The receiving device, *B,* is formed of an equal number of aerial wires, *6a, 6b,* etc., and having the same electrical dimensions as the radiator system at *A.* The devices controlled by the oscillatory currents set up in the resonator system are tuned to the frequency of the oscillation so that the indicating or recording mechanisms connected with each resonator system will be actuated and controlled only by the oscillations induced by the corresponding radiator at the sending station.

The multiple spark-gap shown at *F,* Fig. 3, consists of an adjust-

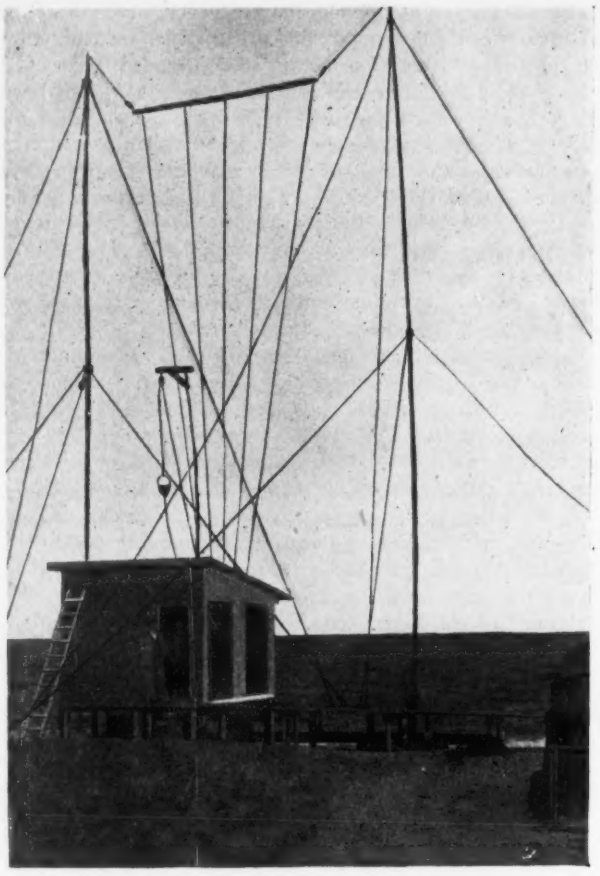


FIG. 7.—VIEW OF STATION AND ANTENNÆ.

able series of rollers between which the spark passes; the multiple spark increases the range of the transmitter and reduces to a minimum the noise of the disruptive discharge, so objectionable where large coils are employed.

These are but a few of the many devices invented and patented by Prof. Fessenden. The apparatus just described, however, is in constant use between the proving stations and operates as decisively, and with the same certainty, as an ordinary Morse instrument.

Electric Lighting in Boston.

According to a publication of the Edison Electric Illuminating Company, of Boston, on February 24, 1903, that company was furnishing electricity equivalent to 867,682 16-cp incandescent lamps, consisting of 481,975 incandescents, 8,064 arcs and 19,800 hp in motors. This was being distributed to 13,067 customers. This is a growth from 300 incandescents in 1886.

A few years ago a comparison was made between the large cities of the world with a view to ascertaining the number of 16-cp incandescent lamps used in each, in proportion to its inhabitants, and the following results were obtained, the figures giving the number of lights per 1,000 population:

	16-c.p. lamps.		16-c.p. lamps.
Boston	1232	Baltimore	373
New York	859	Brooklyn	286
Chicago	730	Edinboro	242
San Francisco	660	Vienna	246
St. Louis	600	Paris	185
Cincinnati	551	London	184
Philadelphia	375	Berlin	176

In view of the great increase of the business of the Boston Edison Company during the last three years, Boston probably still stands in the lead, and with even a greater difference in its favor than when the above statistics were compiled.

Government Telegraphs and Telephones in Great Britain—II.

LONG-DISTANCE TELEPHONE STATISTICS.

In the preceding article a review was made of the report of the British Postmaster-General on telegraphs in 1902-3. Some interesting figures are also given in the report regarding the long-distance service which has been operated by the Post Office since about 1896, when the trunk wire system of the National Telephone Company was bought for about $2,100,000. On the 31st of March last the number of Post Office trunk wire centers was 355, an increase of 27 in the year. The total number of trunk lines in use was 1,309, as compared with 1,165 in the previous year, an increase of 144 circuits in the year. The total length of the long-distance circuits was about 46,740 miles, containing about 93,000 miles of wire. The capital expenditure on the purchase and development of the trunk line system up to March 31, 1903, was $10,462,000, including $1,124,900 spent during the year under review.

The total number of trunk line conversations during the year was 11,574,229. The corresponding figure for the previous year was 10,080,716, the increase being 1,493,513, or 14.8 per cent. This increase was only slightly above the increase in facilities, which was, according to the figures for capital expenditure, just over 12 per cent. The gross revenue from the long-distance service was $1,374,175, as compared with $1,203,280 for the previous year, and the average payment for each conversation was 11.4 cents, which is almost the same as the average value for the last four years.

From these figures it is evident that the Post Office long-distance telephone service cannot be a very paying proposition. The average length of each circuit is 34 miles, which shows that the average rate per mile, at the average value of 11.4 cents per message, is 0.364 cents. The average capital cost per mile of wire has been $112.50, while the average yearly revenue per mile of wire is only $14.75, or 13.1 per cent. on the capital. The average yearly number of messages per circuit is 8,842, equivalent to an average traffic per circuit per working day of 29.4. The rates are extremely low, beginning with 6 cents for distances up to 25 miles, but it is obvious that they have been pitched too low, as a gross revenue of 13.1 per cent. on the capital expended is only about sufficient to pay interest and depreciation charges, leaving maintenance and operating expenses as dead loss.

In the last month of the financial year the charge for a trunk call of six minutes' duration between 8 P. M. and 6 A. M. was made the same as that for a call of three minutes' duration during the day. The time during which the change has been in operation is too short, however, for it to have had any material effect upon the traffic.

TELEPHONES IN THE PROVINCES.

The Post Office does a small amount of telephone business in the provinces and this business shows a slight increase which is treated of with due pride in the report, as follows: "The total number of subscribers to the Post Office exchanges in the provinces has increased to 4,433, as compared with about 3,700 on March 31, 1902. At the end of 1899, when a more active policy was initiated in this branch of business, the number of subscribers to provincial exchanges was about 1,250. The increase in the interval is due not only to the establishment of exchanges in places which are not served by the National Telephone Company, but also to the growth of the business in those areas in which the company and the Post Office have been in active competition. In the South Wales district, for instance, where the number of Post Office subscribers was only about 370 at the end of 1899, the number has now increased to 2,255."

THE LONDON TELEPHONE SYSTEM.

The gem of the Post Office report, however, is the reference to the London telephone service. Great progress has been made during the year, resulting in the establishment of seven exchanges and the partial construction of four others. The total number of subscribers' telephones working in connection with these exchanges on March 31 last was 9,122. The number added during the year was 8,628, and it is believed that this number has not been exceeded during the first year of working of any other local telephone system. The "Central" exchange serves 7,054 of the 9,122 stations in use, and is now the largest exchange in the London area. The other six exchanges are all small ones. The ultimate capacity of the "Central" exchange, which is situated close to St. Paul's Cathedral, is 14,000 lines. The work of extending the switchboard to its full capacity is being rapidly carried on, and plans are in preparation for the construction of another exchange of the same size for the service of the same district. In the construction of all the exchanges on the Post Office system, the necessity for providing for a rapid and continued growth of business has been kept in view. The construction already done provides to a large extent for an increase to 30,000 stations, and to a smaller extent for a still further increase.

The underground system contained 971 miles of pipe, and over 102,000 miles of cable conductor. About 16,700 miles of wire have been used for telegraph purposes, and about 21,800 miles are in use for the telephone service, leaving about 63,500 miles spare. Each line directly-connected with an exchange has involved the provision, on an average, including local junctions, of 1.35 miles of metallic circuit. The average cost of construction has been $92 per mile of metallic circuit. The average subscriber, therefore, costs in line plant $124.20. The total average cost per subscriber, including exchange apparatus, is given as $191, thus placing the central office and sub-station plant at an average of $66.80 per subscriber. The report goes on to say: "If allowance be made for a balance of spare wires, amounting to 25 per cent. of the wires in use, such as is necessary for the efficient working of an exchange system, the average cost will be increased to $222." Here the Post Office officials fall into a strange error. The provision of spare plant in a large telephone system, or even in a small one if development is expected, has to be much in excess of their estimate. A surplus of 25 per cent. of the wires in use is 20 per cent. of the whole plant. The figure that should be taken is more like double this. As a telephone plant is always in process of extension, the spare plant seldom falls below 40 per cent. of the whole. At this rate, which is about the usual figure, the average cost per subscriber would be not $222, but $317. And it is very likely that the average cost per working line of the Post Office London telephone system will never fall below $300, while for many years to come it will be considerably above that figure. At present it is over $600, as the total capital expenditure to March 31, 1903, was $5,562,500 for 9,122 stations.

Taking the capital expenditure per line as ultimately averaging about $300, it is clear that the Post Office London telephone service is destined, at the present rates, to net a handsome annual loss. The rates, as announced in the ELECTRICAL WORLD AND ENGINEER, when they were given to the public nearly two years ago, are $85 for unlimited service and $25 *plus* 2 cents a call for inner London, and 4 cents a call for outer London, on the message rate basis. There are lower rates on the outlying exchanges for party line service. It appears from the accounts that about four-fifths of the Post Office subscribers take service at the message rates, and it further appears that they originate very few calls. This may improve later, but it is never likely to improve very much, as the low flat rate necessarily divides the telephone users sharply into two classes—the moderate and large users who will take the flat rate and the very small users who will take the message rates and remain small users. The message raters have to guarantee $7.50 for calls, so there is practically a minimum rate of $32.50 for from 180 to 360 calls a year, according to whether they are 4-cent or 2-cent calls, and a maximum rate of $85 for unlimited calls. This is a scheme of rates that may please the telephone-using public very well, but has little charm for the supplier—in this case the taxpayer.

Since the English custom is to pay telephone rates yearly in advance it is easy to see what the average revenue per subscriber is. The total for rentals, message fees and public office receipts is $285,435, which gives an average per station of $31.50. This is just 10½ per cent. on the average capital cost of $300. If depreciation be taken at 7½ per cent., which is the usual figure in this country, interest at 3 per cent. and sinking fund at 3½ per cent., a total of 14 per cent., each subscriber would be required to provide $42 a year. So there is a net loss, on a commercial basis of $10.50 per subscriber, without counting operating expenses at all. What the actual operating expenses per subscriber in London may be is not easy to estimate, but we should doubt if, considering the immense area to be served and the difficulty of the work, they will fall below $35 a line when the plant is fairly running, and probably, under government management, not below $40. The total net loss per line will, therefore, eventually be from $45 to $50 per line. This is a conservative estimate, and by no means an extravagant value is placed on any item of expense. To put the matter in another way, in order to make the enterprise commercially sound it would be necessary to obtain an average revenue per subscriber of at least $80 to $90 a line. With a maximum rate of $85 for unlimited service and a minimum message rate of $25, this is clearly impossible. If there were no maximum rate, and message rates exclusively were in force

it might be possible eventually to get the average rate up to a paying figure.

The accounts for the first year's working of the system are of little value for purposes of comparison as the greater part of the system was brought into use during the year, so that the amount for operating expenses is no criterion of a full year's working expenses. They are as follows, pounds being converted into dollars at $5 per pound.

POST OFFICE TELEPHONE SERVICE, LONDON AREA.

An account of the above service from its commencement on March 1, 1902, to March 31, 1903:

RECEIPTS.		
Subscribers rentals:		
In March, 1902		
At flat rates	$3,410	
At toll rates	11,915	
		$15,325
In financial year, 1902-03		
At flat rates	$53,840	
At toll rates	227,590	
	$281,430	
Less proportion proper to year 1903-04	$159,670	
		$121,760
Message fees in addition to fixed minimum of $7.50 per subscriber		2,865
Call office fees (public stations)		1,140
Rentals of wires leased to National Telephone Company		90
Miscellaneous receipts		935
Value of services rendered to gov'm't departments without paym't.		5,100
		$147,215

EXPENDITURE.	
Maintenance of system	$49,100
Salaries, wages, etc., of staff, including provision of pensions of established staff	50,205
Rent, rates, fuel and light, including estimated rental value of premises already belonging to the department	12,950
Miscellaneous expenses (stationery, traveling, etc.)	4,135
Balance available towards meeting depreciation, interest etc. (vide notes)	30,825
	$147,215

NOTES.

1. The estimated amount required to provide for depreciation of plant, inclusive of spare wires, is $137,475, and interest at 3 per cent. on the capital expenditures of $5,562,500 is $166,875, making together $304,350.

2. Terminable annuities have been created, payable from the vote for the telegraph service, to provide for the repayment, with interest at 3 per cent., of capital raised for telephone purposes under the Telegraph Act of 1899. The proportions proper to the London telephone service of the annuity payments already made are as follows: Payment on April 1, 1901, $122,030; payment on April 1, 1902, $288,863.

3. The annuities provide for the repayment of the capital in 12-15 years, while the estimated life of the plant averages 36 years. The annuity required for interest and sinking fund on a capital expenditure of $5,562,500, repayable in 30 years with interest at 3 per cent., would be $283,920.

These notes are a highly interesting commentary on the balance sheet. From note 1 it appears that to meet depreciation—which is reckoned at slightly under 2½ per cent.—and interest at 3 per cent., a sum of $304,350 is required. The actual amount available as gross profit from the first year's working is $25,725. A balance of $30,825 is shown in the balance sheet, but the sum of $5,100 "value of services rendered to government departments without payment" is ingeniously shown as a receipt whereas it is, of course, not really a receipt at all. So that on this basis there is a loss on the first year's working of $288,625. Even assuming that the present plant can serve three times the present number of subscribers, which is a liberal assumption, and that the operating expenses remain proportionately the same, which is also assuming what is unlikely to be the case, there will still be a deficit of over $235,000 a year.

This is on the basis of the very modest figure for depreciation of 2½ per cent. It seems to us that the Postmaster-General is oversanguine in estimating the depreciation of telephone plant at as low a figure as that, and that past experience, in this country at least, does not warrant the assumption that the average life of telephone plant will be anything like 36 years. Conservative American telephone men put telephone depreciation at no lower than 7½ per cent., and even granting that telephone plant might be expected to show greater stability and endurance under British Government management than under the strenuous conditions of American commercial development, it would hardly seem safe to put the depreciation at a lower average figure than 5 per cent. Adding interest at 3 per cent., a gross profit would be required sufficient to pay 8 per cent. on $5,562,500, or $445,000 annually.

But the notes show that even more is required of the returns from the system. If the capital were to be repaid in 30 years sinking fund and interest would absorb just over 5 per cent. on the capital, or $283,920 a year. But the annuities created for the repayment of the capital practically constitute a sinking fund to extinguish the capital within 15 years, and to provide for this requires annually about 8½ per cent. on the capital, or $472,000 a year. This would mean, with depreciation at the Postmaster-General's figure of 2½ per cent., a total of $611,875 a year, or with depreciation at the more conservative figure of 5 per cent., $751,000 a year. If the present plant proves capable of serving three times the present number of subscribers, and the present ratio between operating expenses and revenue is preserved, the plant will eventually produce a gross profit of about one-tenth of the last named sum.

It is well known that the Post Office has put in a thoroughly modern plant for its London service, but the department cannot be congratulated on the business aspects—or prospects—of its telephone venture. The Postmaster-General has informed the British public, through the House of Commons, that his London telephone system was expected to prove a profitable enterprise, but the figures he presents show that such an expectation is little likely to be realized. It is rather a sad spectacle to see British postal telephones following British postal telegraphs along the inglorious path of annual deficits, especially in view of the recent declaration of the Postmaster-General that he could not conceive of any successor of his in office allowing private enterprise to continue in the management of the telephone service when the telephone licenses expire in 1911. During the past year private telephone enterprise paid the Postmaster-General in royalties no less than $815,000. This princely sum, paid for the mere right to exist, gets a line in the report. As a mere question of dollars and cents it would look as if the Post Office would do better to leave the telephone service to private enterprise.

Coming back to the financial results of the telegraph department, we find that the total expenditure for the year was $21,586,855, and the total receipts, including an amount of $460,605 "estimated value of services to other departments," $18,619,330, leaving a net deficit of $2,967,525. This requires some modification, however. The Post Office keeps no capital account and makes all its extensions out of revenue. As the Post Office as a whole, postal and telegraph services combined, makes a net profit of $17,900,000 a year, over and above all expenditures, it can well afford to do this. In case of the telegraph finances, extensions and buildings account for a large sum, $2,450,775 for the year under review. Deducting this from the gross deficit of $2,967,525, we get a net deficit of $516,750 on the actual working. To this should properly be added the sum of $1,494,300, the annual interest on the stock created for the purchase of the telegraphs in 1870 (which was about $50,000,000), making a total deficit of $2,011,050. What the present capital value of the British postal telegraph system is the report does not state. Sir William Preece, in a recent lecture, put it at not less than thirty millions sterling, say $150,000,000, which is probably not an excessive estimate. If interest were paid on this sum at the same rate as on the original capital, the present annual deficit would be almost exactly $5,000,000. Perhaps the British public may be congratulated on having acquired, out of the profits of the Post Office as a whole, a telegraphic system worth thirty millions of pounds and admittedly fairly efficient. But on the whole our sympathy is with the critics of the Post Office who systematically condemn the steadily increasing telegraphic deficit. As a specimen of business management, the administration of the telegraphs and telephones certainly does not reflect credit on the British Post Office. It should prove a warning to those who advocate Federal ownership of telegraphs and telephones in this country.

Statistics of the Street Railway Industry.

At the convention of the Street Railway Accountants of American Association a very able and interesting paper was presented by Mr. W. M. Steuart, chief statistician of the Department of Manufactures, United States Census Office, on the work done by the Office in compiling the figures of the industry since he appeared before the body at the Detroit convention last year. The leading data have already been published in these columns, but Mr. Steuart brought up a number of new facts and threw various side lights on the statistics obtained. In doing this he emphasized alike the importance of the work done by the Cenusus Office and of that which the Accountants' Association is trying to do, and he enlarged on the necessity of "standardization" in this respect.

The extent to which the roads are patronized is indicated by the fact that more than 5,800,000,000 passengers of all kinds were carried during the year. This is sufficient to give more than 200 rides to each inhabitant of the cities and towns having a population of 4,000 or over at the census of 1900. They give employment to an army of 140,000 persons, thus making at least 560,000 dependent upon them for their support. The salaries and wages paid annually to their operatives amount to more than $88,000,000. The average annual wages per operative compare favorably with those in other lines of industry, and there are very few that give constant employment to a larger force or have a larger pay roll.

The financial transactions of the companies are rapidly approaching proportions which will outclass those of our largest industries. The authorized capitalization in 1902 amounted to $2,870,629,316, while the gross earnings from operation were $247,553,999, and the net income after deducting all expenses, both operating and fixed charges, was $30,596,977. The statistics for the physical equipment of the roads indicate the great diversity of industries that are, in a measure, dependent upon them for their prosperity. The construction of 22,577 miles of track was a great stimulant to the steel rail market, while the building of 67,000 cars made a great demand on the numerous industries dependent upon such work. The manufacture and installation of the engines and boilers to generate more than a million horse-power reported for the power plants of the electric railways was sufficient to keep our largest foundry and machine shops busy for many months. The extent to which the manufacturers of electrical apparatus are dependent upon the roads is indicated by the fact that almost 5,000 large generators, transformers, boosters, auxiliary generators, rotaries and motors were in use, also over 16,000 storage battery cells, and this does not take into consideration the electrical equipment of the cars, wiring of the road, or the lighting and telephone facilities.

The Census Office received reports from 987 companies, but if the present rate of consolidation is continued for another decade, the office could secure reports for two-thirds of that number and still cover the entire trackage. The term company or establishment is rapidly losing its significance in important industries. It is of no statistical value in the report on electric railways. If the word "system" could have been used to designate the number of separate holdings it would probably have conveyed a more exact meaning, but this was impossible because in some instances separate reports were made for constituent companies. The two systems in the District of Columbia insisted on making eight reports, and would not be satisfied until they were counted eight times. There were nine companies operated by regular steam railroads as an auxiliary of the railroad business. Eleven companies operated incline planes exclusively and, therefore, cannot be strictly classed as street railways. There were also 53 companies operated exclusively by animal power, 2 by cable, and 3 by steam. Eliminating these and the 170 lessor or non-operating companies, there remain 739 companies, with 18,730.20 miles of single track, to which the standard system of accounting could be considered as applicable. But a large number of these companies have complicating features that are difficult to overcome in the application of such accounting. For instance, 252 companies generate electric current for sale, and the business was of much importance that separate reports were secured for the light and power plants of 118 companies, in which the revenue from the sale of current amounted to $6,469,726. The present Association form of account does not take sufficient cognizance of this feature of the industry. It is a feature that appears to be developing very rapidly and should be recognized in any system that is to be made of universal application. After deducting the 252 companies that generate electric current for sale, there were 487 companies, and of these, 50 operate gas plants, waterworks, or some other industry that has no connection with the railway business. There are, therefore, only 437 companies to which the standard form of accounting is strictly adaptable.

Mr. Steuart urged, therefore, the adoption of accounting forms that would cover light and power and all other branches of the present comprehensive corporations; and he proceeded also to speak of the later interurban developments. He stated that it had been found that making a separation of the roads, it is found that about 300 companies can be considered as operating interurban lines. Their total single track amounted to 8,853.53 miles, and their total earnings from operation for the year to $41,099,987; total operating expenses were $26,135,031, the net earnings being $14,964,856. The single track of these companies forms 39 per cent of the total for all companies, and their operating earnings 17 per cent of the total earnings from operation. The interurban traffic, therefore, forms still only a very small proportion of the total electric railway business. There are about 56 companies, with 3,212.75 miles of single track, that operate what may be classed as fast long distance interurban lines. Each of these companies operates at least 20 miles of road, the average length of single track per company being 57.37 miles. The maximum running speed outside city limits was at least 25 miles per hour. The total operating earnings amounted to $13,657,021, and the operating expenses $7,924,568, the net earnings being $5,732,453. These roads have some features which are distinctive, and the Census Office is now preparing an analysis of their statistics which will be included in the final report.

As to the horse car line, Mr. Steuart remarked that it had been electrocuted in almost every city where it was in a flourishing condition a few years ago. While there were 67 companies using animal power and 259.1 miles of track operated by such power, the greater proportion of the track was owned by companies which used other motive power on a portion of the line. There were only 53 companies which used animal power exclusively, and their single track amounted to 158.12 miles, being an average of about three miles for each company. It is strange that the Metropolitan District, in which the most advanced electrical appliances are in use on the street railways, is also the home of the antiquated horse car. Almost half of the trackage operated by animal power is located in Manhattan, and the Dry Dock, East Broadway and Battery Railway is the largest road operated by a company using animal power exclusively. With the exception of New York, the following cities are the only places in which more than five miles of track were operated by animal power in 1902: Hutchinson, Kansas, 7.83 miles; Santa Rosa, Cal., 7.33 miles; Chicago, Ill., 6.76 miles; San Francisco, Cal., 5.65 miles; Arkansas City, Kansas, 5.50 miles, and Tucson, Arizona, 5.10 miles. The cable, which fifteen years ago had such bright prospects, is now antiquated. There are only two street railways operated exclusively by cable power. From the Census Bulletin there appeared to be twelve roads of this character, but ten of them are inclined planes.

Mr. Steuart then presented some financial criteria, remarking that the tendency in most lines of industry is toward over-capitalization, and the conditions prevailing in the electric railway business seem to have been especially conducive to this result. The par value of the common and preferred stock on which no dividends were paid during the year amounted to $667,878,624, or about 50 per cent of the total issued. The practice of some companies to equalize the cost of construction with the amount of capital stock and bonds, and the apparent inability of others to furnish definite information concerning the cost of construction, with the amount of capital stock and bonds, and the apparent inability of others to furnish definite information concerning the cost of construction, made it impossible to compare the actual cost with the stock and bonds issued. Accepting the figures as reported, it appears that the stock issued and the funded debt outstanding for all roads, exceeded the cost of construction by $140,648,022.

With regard to the adoption of the Association form of accounting, Mr. Steuart stated that the Census Office immediately ascertained to what extent it had been used by the State Railroad Commissions. The commissions in New York, Massachusetts, Connecticut, Maine and New Hampshire were using schedules that followed the form almost exactly. These five States contain 6,386.92 miles of single track, or 23.30 per cent of the total trackage in the United

States. This fact alone would have justified the office in using the standard form; but it was also found that a number of other States had collected information from which the schedule could be partially prepared. Pennsylvania is one of the most important States that had not adopted the standard form, but the Commissioner informed Mr. Steuart that it was his intention to do so. The adoption of this form by the officers in all States would aid greatly in its uniform application, and it seems that the Association should endeavor to accomplish this by persistent work with the State Commissioners. In this manner the burden resting upon the companies of making reports that are in part repetitional or duplicates would be greatly alleviated. Mr. Steuart then cited a number of amusing and interesting instances of crude bookkeeping encountered in different sections of the country, and devoted the final portion of his paper to an elaborate discussion of the technical features involved in existing and improved methods of accounting.

William Gilbert of Colchester.

The accompanying reproduction is made from a photograph expressly taken for reproduction here of the statue of Gilbert, still standing at this day in one of the niches of the Chapel of St. John's College, Cambridge, and is believed not to have before appeared in print. The great father of experimental philosophy is here shown

STATUE OF WILLIAM GILBERT.

in manner different from that exhibited, either in the well-known portrait said to have been engraved by Clamp in 1796, "from an original picture in the Bodleian Library, Oxford," or in the painting which, upon the occasion of the tercentenary celebration of Queen Elizabeth, was made by Mr. Frank Daniell for Mr. Benham, who gave it to the new Town Hall at Colchester, where it now hangs in the Mayor's parlor.

The original portrait which Gilbert is said to have left to the University of Oxford, and which was "placed in the Gallery over the Schools," is reported to have been consumed in the great London fire of 1666, although Anthony À Wood speaks of it as "decayed and removed" (Hist. and Antiq. . . . ," 1796, Vol. II, p. 96). The writer in Ninth Encyl. Britann., speaking of this portrait, says that Gilbert therein appears as standing in his doctor's robes, "holding *in* his hand a globe inscribed *terrella,* whilst over his head is the inscription, '1591, aetatis 48,' and a little below his left shoulder the words, 'Magneticarum virtutum, primus indagator Gilbertus.'" The Clamp picture lacks the inscriptions and represents Gilbert resting his hand *upon* an ordinary globe. We may add that it was the central portion of this picture which was utilized by Mr. Arthur Ackland Hunt for his well-known historical painting, representing Gilbert making an experimental demonstration in electricity before Queen Elizabeth.

In the Daniell painting above alluded to, the inscriptions have also been omitted. Gilbert is resting his right hand upon a globe whilst in his left he carries a rolled manuscript bearing in Elizabethan characters the words *De Magnete.* The painting itself bears a plate inscribed as follows: "William Gilbert, of Colchester, Physician to Queen Elizabeth and King James I, author of *De Magnete* and founder of the Science of Magnetism. Born 1540, died 1603. Presented by Charles E. Benham."

The reproduction of the statue herein made is the first one we know of showing the full figure and costume of Gilbert. The pose, the arrangement of the beard, the style of the ruffle, are altogether original, and, for the first time, he is seen holding a bar magnet in one hand and a mariner's compass in the other. The statue bears out Dr. Fuller's description of Gilbert. "His stature was tall, complexion chearful, and Happiness not ordinary in so hard a student and retired a person," and shows likewise "the keen, straightforward, searching glance, the twinkling play of good-humoured sarcasm, ready to vent itself on all 'old wives gossip' and 'foolish vanities,' the frank, fearless, open countenance, intolerant only of shams and fraud," as expressed by Mr. Benham in the "Sketch of Gilbert's Magnetic Philosophy," which he published at Colchester during the past year.

In this connection it may be said that the inscription on Gilbert's tomb in Trinity Church, Colchester, reproduced in the last-named work, indicates that Gilbert was 63 at the time of his death. Prof. Silvanus P. Thompson's latest researches, however, show that Gilbert was *certainly* not born in 1540, but in 1544, and that, contrary to the generally accepted belief, he was only 59 years of age when he died. Inquiries now being actively instituted abroad in several directions will soon set this question at rest.

The first signature of Gilbert discovered came to light some five years ago attached to a medical certificate in Her Majesty's Record Office. Up to that period, not one example of his handwriting was known, but in the meantime several signatures have been found in books of St. John's College, where Gilbert matriculated during May, 1558, and Prof. Thompson mentions the fact that he has recently found a volume of Aristotle bearing Gilbert's own marginal notes, some of which will no doubt be reproduced at an early date.

Tunnel Under Washington.

The Commissioners of the District of Columbia have granted a formal permit to the Philadelphia, Washington & Baltimore Railroad (the Pennsylvania road) to construct the twin tunnel under the United States Capitol and the adjacent blocks and streets. The permit had been held up for several weeks because of a difference between Major Biddle, the engineer commissioner, and the railroad engineers in regard to the motive power to be used to propel cars in the tunnel. Major Biddle insisted that electricity should be used, and the railroad men wanted to be allowed to use steam. Electricity was finally agreed on. The tunnel will be 3,000 ft. long, beginning at the intersection of Massachusetts Avenue and First Street, N. E., going under Capitol Hill to New Jersey Avenue and D Street, S. E. The total cost of the work will be approximately $800,000. There will be two branch tunnels connecting with yards and tracks of the Pennsylvania road in South Washington.

The Value of Radium, Roentgen Rays and Ultra-Violet Radiations in Mineralogical Determinations.

WITH the advent of Kunzite, the newly-discovered gem, and its remarkable behavior when subjected to the action of radio-active substances and electromagnetic radiations as observed by Dr. George Frederic Kunz, late president of the New York Mineralogical Club, and Prof. Charles Baskerville, head of the chemical department of the University of North Carolina, fresh stimulus has been given to the study of the new properties of minerals acquired in a radio-active field.

Before presenting these remarkable phenomena a brief history of the stone named in honor of Dr. Kunz will be given. A gem believed by mineralogists to be extinct was noted by Dr. Kunz in his treatise on precious stones[1] some ten years ago, the data being obtained from spodumene, a mineral generally found in large, opaque whitish crystals, but which sometimes appears as highly colored transparent specimens of very small size.

These are the clear yellow gem-spodumene of Brazil[2], the green variety known as hiddenite or lithia emerald of North Carolina, and the lilac or amethystine specimens found occasionally at Branchville, Conn.[4] These minute crystals are plainly remnants of what must have once been elegant specimens,[5] but this special spodumene was extremely susceptible to alteration, and the finer properties of the larger specimens have been destroyed through their environments and their transparency and beauty of tint eliminated.

From these remaining fragments the doctor was enabled to approximate their appearance when in the perfect state and classified as precious stones. Nearly nine months ago spodumene crystals, unaltered, transparent and of a rich lilac color were discovered near Pala, California, and specimens were sent to Dr. Kunz for classification, and it was ascertained by him that these were not only different from all other minerals heretofore examined, but also fulfilled to a nicety the conditions exacted by the extinct stone previously described in his work.

These newly-discovered crystals of spodumene measured 10 x 20 x 4 centimeters and are not only of extraordinary size, but are of exceeding beauty and transparency as well; in color they vary from a rich deep rosy lilac to pale and almost colorless crystals, depending on the depth from which they are obtained, the striking colors being found at considerable depths and the colorless varieties near the surface of the earth.

Up to a very recent date this new gem was without a name, but while Dr. Kunz was on his vacation Prof. Baskerville, in view of the acute observations of the eminent mineralogist, cleverly proposed the name of Kunzite, which was heartily received by scientists both at home and abroad.

Fig. 1 illustrates photographically crystals of Kunzite, the size

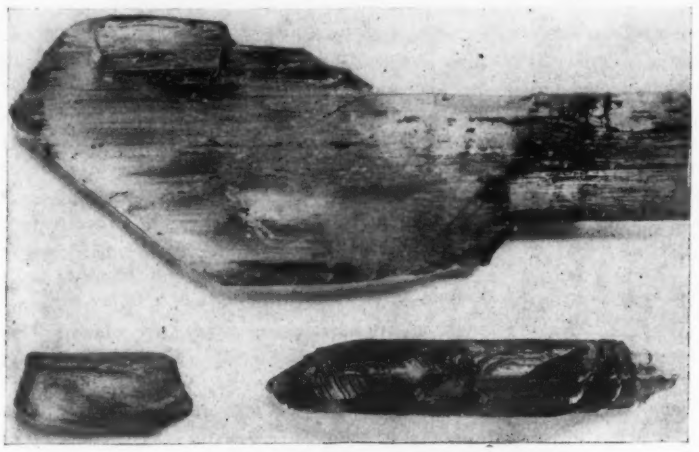


FIG. 1.—CRYSTALS OF KUNZITE.

being relatively indicated. The dimensions and weights of six of the largest crystals are here appended.

[1] Gems and Precious Stones of North America, Kunz, third edition, 1892, page 150.
[2] Pigani, Comptes Rendus, 84, 1509, 1887.
[3] J. L. Smith, Am. Journal of Science, 21, 128, 1881.
[4] Penfield, *id* 20, 259, 1880.
[5] Kunz, Science, 452, 280, Aug. 23, 1903.

Dr. Kunz and Prof. Baskerville have subjected these magnificent crystals to the bombardment of the Röntgen rays having high

	Weight, grains.	Weight, troy.	Dimensions, centimeters.
No. 1	528.7	17.1	17x11x1
No. 2	528.7	17.1	22x8x1.5
No. 3	597	9.55	19x5.5x1.5
No. 4	256.6	8.25	23x4x2
No. 5	340.5	10.95	13x6x2.53
No. 6	239.5	7.70	18x4x2

penetrative powers, yet on examining the stone in a dark room they emitted a white light for as long a period as twenty minutes, whereas with all other specimens of altered and unaltered spodumene obtained from Brazil, North Carolina and Connecticut included in all the private and public collections available, none was found to produce a similar effect.

Again, it was found that a crystal 2x4x10 centimeters, excited by a stream of Röntgen rays for a few minutes, set up a secondary radiation by which a radiograph of the crystal itself was easily made on a sensitized paper by its own emanations, and even when thin paper was interposed between the radio-active crystal and the light sensitive paper the radiation still was active. These savants have shown that this phosphorescent property is not confined merely to the surface of the crystal but persists throughout its mass. Fig. 2 is a

FIG. 2.—RADIOGRAPH OF KUNZITE CRYSTAL.

radiograph of Kunzite crystal made with a 12-in. spark coil and a self-regulating tube, with an exposure of 60 seconds. Oppositely disposed, ultra-violet radiation does not produce the slightest indication of fluorescence or phosphorescence when Kunzite is subjected to its action.

The Kunzite is highly dichroic in the darker specimens, and with the dichroscope the darker specimens show a rich, deep purple for ordinary rays, and a pink for the extraordinary rays. For a lighter crystal, almost like pink topaz in color, the ordinary ray is transformed into pink, and the extraordinary ray showed almost no color, having an approximately white appearance.

A small quantity of radium of 300,000 radio-activity and the purest yet received in this country reached the American Museum of Natural History (New York City) a few days ago, sealed in a small glass tube with an outer casing of lead-foil, the total diameter being about 3 centimetres. This, as well as a quantity of 7.000 activity was employed by Dr. Kunz and his colleague, Prof. Baskerville, in

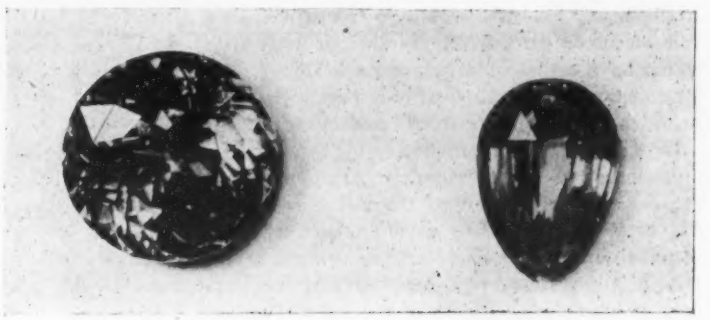


FIG. 3.—GEMS CUT AND POLISHED.

the examination of the hitherto unrevealed properties inherent in gems. Not only was Kunzite subjected to its searching influence, but the entire Bement-Morgan collection—over 13,000 specimens in number—and the Morgan-Tiffany collection of gems containing several thousand specimens, together with some thousands of different diamonds and a large number of gems and minerals, were investigated.

Fig. 3 shows two forms of Kunzite gems cut and polished, and it

was ascertained that after these specimens were influenced by the radium they emitted a wonderful phosphorescence. Figs. 4 and 5 illustrate how the experimenters protected themselves from the untoward effects of the radium—such as it may possess. Two corks with a piece of lead-foil inserted between them was securely fastened together with the tube of radium suspended over it, as shown in Fig. 4, which is a top elevation. Fig. 5 shows the lead-foil projecting forward and the little apparatus in position so that the radium will emit its corpuscles directly on the gem held under it. The tube is snugly tucked away, not only that it may not sustain damage to itself but so, too, it may not accidentally sear the flesh or destroy the vision of those in whose keeping it is entrusted.

The radium, now the property of the Museum, was acquired through the courteous gift of Edward D. Adams, Esq., for the especial purpose of the researches recited above. By its aid diamonds exhibit a marked phosphorescent property, which they retained for a time after the stones are removed; other diamonds, on the other hand, do not phosphoresce at all; this striking example was most not-

FIGS. 4 AND 5.—RADIUM TUBE OF 300,000 RADIO-ACTIVITY.

able in a cut gem weighing 15½ carats, of a beautiful white color and from an unknown Brazilian locality; others of the same class were uncut gems found in British Guiana, and a large diamond weighing 16 carats found at Eagle, Wis. The mineral Willemite exhibited a fluorescence and phosphorescence, and Wollastonite a marvelous phosphorescence, but the new gem, Kunzite, phosphoresced with a greater brilliancy than any other substance examined with radium. When the radio-active matter was held under the entire gem, which measured an inch in diameter, an inch in depth and weighing 55 5-16 carats, it glowed with an orange-red color, and its phosphorescent emissions penetrated from three to six sheets of paper.

It is pleasing to note that this work has been taken up by men so remarkably well qualified as Dr. Kunz and Prof. Baskerville. The latter is a graduate of the University of Virginia and is Professor of Chemistry in the University of North Carolina, Chapel Hill, N. C., and has made extensive researches in what is known as rare earths, which have attracted so much attention in recent years, as it is the incandescence of these earthly minerals that has been the subject of so much experimenting in gas and electric lighting.

Dr. George F. Kunz first gave his attention to the subject of phosphorescence about 1875, and in April, 1876, he read a paper before the New York Lyceum of Natural History on the phosphorescence of pectolite by attrition as a distinguishing characteristic between it and the fibrous zeolites. He next made a series of experiments on the phosphorescence of the diamond at the Paris Exposition of 1889 jointly with Prof. E. Mascart, the well-known electrician. Prof. Kunz continued his researches on his returnn to America, and finally deduced the sweeping law that all diamonds phosphoresce by attrition. He published a statement to the effect that certain diamonds from Brazil absorbed sunlight and some of them ultra-violet radiation, which they emitted in the dark in the form of light waves, and that this effect was due to the presence of some substance, possibly a hydro-carbon, to which he gave the name of Tiffanyite. This phenomenon was shown in an electrical exhibition at Grand Central Palace, New York, in 1896, for an entire month, where it was viewed by thousands of spectators. The experiment was conducted in a specially-constructed room, where the diamonds were shown in white light and under ultra-violet radiation, and then allowed to phosphoresce in the dark.

Dr. Kunz discovered as early as 1887 that chlorophane, a mineral from Amelia County, Va., emitted light by attrition, and that it phosphoresced by the glow of the hand, which proved to be a distinguishing characteristic between it and other varieties of fluorites. He has also made an exhaustive study of fireflies and glow worms, both in the United States and Europe and Asiatic Russia.

With this wide experience in testing gems, together with the subtle aid which X-rays, ultra-violet radiation and radio-active substances will give in the exploration of regions hitherto inaccessible through the medium of microscopy, spectrum analysis and chemical analysis, we must not be surprised if phenomena even more noteworthy be presented for our consideration.

For twenty-one years Dr. Kunz has been a special agent in charge of precious stones for the United States Geological Survey; received the honorary degree of Ph.D. from University of Marburg, Germany, and A. M., Columbia University.

Recent Electrochemical Developments.

BATTERY INVENTION.

All electrochemical patents issued on September 8 relate to battery inventions. Three of these were granted to Mr. Oliver P. Fritchle, of Denver, Colo., for a process and apparatus for producing the active material of lead storage battery plates. Particles of finely-divided lead are produced by spraying molten lead by means of a blast through a hot cleaning solution, such as a hot dilute solution of hydrochloric acid; by this means the particles are claimed to obtain a peculiar cohesive property, so that they may be welded together into a rigid but highly porous mass, by subjecting the material to light pressure. The treatment with acid causes a slight evolution of gas, which prevents the particles of lead from settling into a dense compact mass. The porosity thus produced is said to be sufficient to allow easy diffusion of the electrolyte, which is after all the fundamental condition to be fulfilled in an efficient storage battery plate.

A patent, granted to Mr. George E. Hatch, of Quincy, Mass., refers to the type of lead accumulator which has been developed in recent years by this inventor. Each positive-pole electrode is composed of a rigid porous support plate of kaolin, corrugated in one direction. In this way a number of parallel grooves are provided which are filled on one side of the plate with active material. For the negative-pole electrode he employs thin porous plates of light wood. Each plate has the form of a shallow tray, with a profusion of holes piercing its bottom; the active material is filled into this tray, which serves to support and give form to the active mass during the process of formation; but as by the formation the active mass becomes a firm, coherent and durable mass of spongy metallic lead which will not crumble, the trays may be very thin and light, and not nearly as rigid as the support plates of the positive-pole electrode. The conducting plates are thin sheets of lead. One of these sheets is placed in contact with the active material in a support plate of the positive-pole electrode; against this support plate is placed a tray containing the active material of the negative-pole electrode, and this active material is then placed against another conducting sheet of lead; this combination represents a couple which may be held together by any suitable means.

The advantages which a commercial lead-zinc cell would have over the lead accumulator—higher e.m.f. and lighter weight—are so evident that the long series of commercial failures of various forms of the lead-zinc cell does not prevent new inventors from taking up the old problem. In two patents granted to Mr. Lothar Fiedler, of London, a new modification of the lead-zinc cell is described. The one electrode is the ordinary peroxide plate, while the other has an active surface of cyanide of zinc and mercury and is made as follows: A plate of zinc or carbon is treated as cathode in an electrolyte made of 1,000 grams zinc sulphate, 50 grams mercuric sulphate, 10 grams potassium cyanide and diluted with water to a density of 30° Baume. The anode is zinc and during electrolysis the density of the electrolyte is kept constant. On the cathode cyanide-zinc amalgam is deposited in a firm, even and porous condition, so that when used in the lead-zinc cell it has no

disposition to become detached from its support. The electrolyte used in the inventor's lead-zinc cell is a gelatinous mass, made up of 1,000 grams of a solution of 24° Baume of sodium silicate, of 3,000 grams of a solution of 33° Baume of sulphuric acid, and of 50 grams of mercuric sulphate. After this solution is compounded it is at once poured into the cell and in a little time it solidifies into a jelly-like mass.

New Telephone Patents.

INDUCTION COMPENSATION.

There are always at hand two ways of increasing the volume of transmission over a line, the one the use of a more sensitive receiver and the other the adoption of a more powerful transmitter. The first is always attended by additional disturbance from line induction, while the latter means more wear and tear on both batteries and transmitter. As a happy medium Messrs. William Condon and Albert Barrett, of Kansas City, have adopted and protected by two patents what they term an "Anti-Induction" system, comprising arrangements such that the receiving efficiency may be reduced and the transmitter power correspondingly and simultaneously at will. When too increased much noise appears at the receiver, the number of battery cells in use with the transmitter is increased until the voice currents overpower the disturbing currents on the line. The receiving efficiency, however, being reduced simultaneously with the connection of additional battery, approximately constant volume of speech appears at the receiver.

LOADING COILS.

Two patents have been granted describing self-inductive loading coils of odd construction. These coils are both of the open mag-

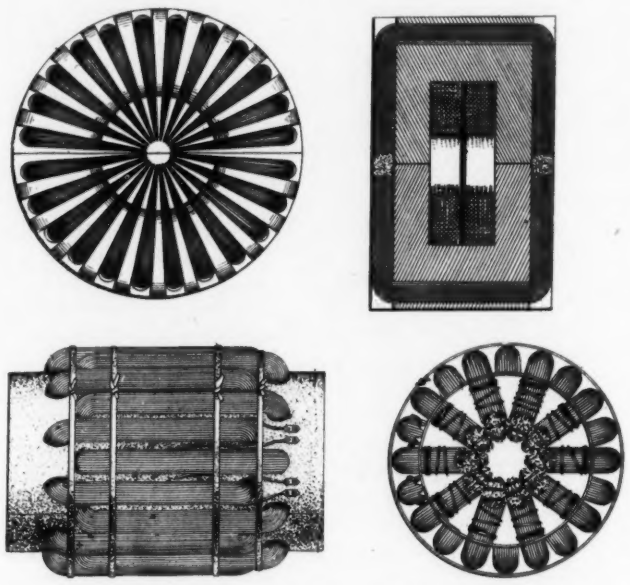


FIG. 1.—CAMPBELL AND RICHARDS LOADING COILS.

netic circuit type and are the inventions of G. A. Campbell and W. L. Richards, who have assigned them to the American Telephone & Telegraph Company. Fig. 3 shows views of both coils. In each it will be seen that the magnetic iron wire is disposed about the outside of the coil, the stray field threading the coil and therefore much confined. The result is a coil which should be rather free from disturbing effects upon other coils, which, in the loading of cables, must be located near it.

A FEW SUBSCRIBER'S AIDS.

The receiver holder again appears in a patent issued to E. Bass, of New York. This time it is a simple bent wire at the end of which the receiver is held. A wall bracket and a spring to force the receiver toward the head of the user complete the device proper. The inventor thoughtfully suggests a plug to be forced into the escutcheon plate of the regular hook switch when it is desired to hold this latter in its normal depressed position.

Another aid is a tell-tale for a magneto bell to assist one who has more than a single telephone to answer. This tell-tale is a piece of sheet material peculiarly perforated and slotted, so that it may be hooked over the bell hammer rod and there remain supported in an elevated position until the rod is vibrated, when the tell-tale will fall and indicate which bell has rung. Charles E. Monroe, of New York, is the patentee of this device, which has been assigned to the Ericsson Telephone Company.

Still another attachment is an extension bell switch, which is held open by engagement with the magneto bell hammer rod. Being released as was the preceding device, the switch falls, closing a battery bell circuit. George L. Gulliford, of Bloomington, Ill., is the inventor of this device.

A memorandum paper holder constitutes the fourth subscriber's aid. This is a bent wire holder, which will clamp itself to a wall set back board and shelf to support and provide a guide and tearing edge for a roll of scratch paper. The patent for this paper holder has been issued to W. H. Sherman, of Newport, R. I.

AN IMPROVED COIL TERMINAL.

All those who have had much work about relays appreciate the annoyances of loose coil terminals, and yet heretofore no cheap and satisfactory terminal has been devised. The application of heat

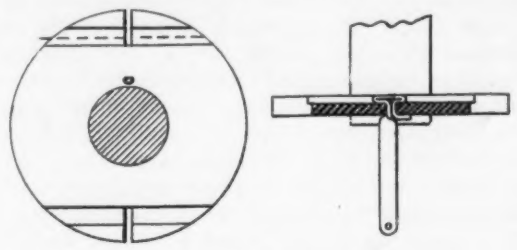


FIG. 2.—DUNCAN ELECTROMAGNET.

from a soldering iron to the insulating coil head causes this latter to soften and become distorted by the terminal piece owing to the side pressure of the iron. Fig. 4 shows a terminal designed to be readily tightened in case it becomes loose. As will be seen, the metal strip is bent up like a McGill fastener and slipped into a radial slot in the spool head. After being pulled down into the transverse slot, one clip is bent over and the other given a quarter turn to hold the whole together. If the terminal loosens at any time an additional twist will tend to tighten it. Mr. James Duncan, of Boston, has patented this new terminal, his patent being assigned to the American Telephone & Telegraph Company.

TRUNK CALLING SIGNAL CIRCUIT.

An automatic trunk signal circuit has been devised by W. M. Davis, of Chicago. This circuit is more particularly adapted to work in connection with the switchboard circuits of the same inventor and operates to notify automatically the operator at the receiving end of a trunk wire by the lighting of a lamp that a subscriber has been connected to the other end of that trunk and awaits attention. A ring back signal is provided for emergency use, and the common batteries of the two central offices involved are kept distinct by condensers and repeating coils.

SENSITIVE DROP AND RELAY.

Mr. Davis has also invented a magneto drop signal with a battery auxiliary for use with very long lines, where the hand magnetos fail to send sufficient current for the ordinary drop. The line drop has two armatures swung before the same core. One merely controls a battery connection, while the other actuates the shutter hook. The contact armature responding to a weak current comes up to its contact and thereby closes the battery circuit through the coil. The additional pull caused by the battery current causes the hook armature to operate until such time as a contact in the line jack again opens the battery circuit and releases both armatures. The corresponding clearing-out signal is double-wound, one winding being for the battery and one for the line. In this case a socket switch associated with the plug socket reopens the battery circuit. To Mr. Davis is also due a new relay. In this the armature pivoted to a pole-piece at one end of the core swings toward a second pole-piece at the other end, and through the agency of an insulating rod controls contact springs secured to the spool on the side opposite to the armature. All three of Mr. Davis's patents have been assigned to the Stromberg-Carlson Company.

ONE-WIRE TRANSMISSION.

From time to time brief mention has been made in these columns of various ones of a series of patents for multi-induction coil systems, of which Mr. C. G. Burke is the inventor. These earlier systems all provide a number of induction coils of differing electrical properties

having the primaries in the line and the secondaries in a local circuit with the receiver. With such systems it has been claimed that but one wire is necessary to satisfactorily transmit speech. Some time ago in reviewing this claim we suggested that the action was probably due to the capacity effects of the additional induction coils. That such is the case is evidenced by two later patents bearing on this subject, the one granted to Mr. Burke and the second to R. A. Ripley. Both relate solely to the transmission of speech along a single wire, a "capacity body" such as a condenser, a battery, the human body or an induction coil with a short-circuited low-resistance winding being connected to line beyond the telephone receiving apparatus. It seems incredible that such an arrangement could compete with modern two-wire transmission, especially as with the single-wire it is impossible to neutralize extraneous inductive effects.

The Edison Convention.

As predicted in our report last week of the opening of the convention of the Edison Illuminating Association at the Hotel Fontenac, Thousand Isles, the meeting was a very successful one in attendance and in the character of the papers read and the discussions they brought forth. Our report gave a complete programme of the technical proceedings, which was carried out in its entirety. On Thursday night Mr. C. P. Steinmetz gave an interesting lecture on "Illumination," and during the week there were a number of social features, including golf and bowling contests, a croquet tournament, a progressive card party and a "mixed foursome" tournament.

Following are the officers elected for the ensuing year: President, Mr. J. B. McCall, of Philadelphia; vice-president, Mr. C. C. Perry, of Indianapolis; secretary, Mr. W. S. Barstow, of Portland, Ore.; treasurer, Mr. Alex. Dow, of Detroit. Executive Committee—C. L. Edgar, Boston; Samuel Insull, Chicago; J. W. Lieb, Jr., New York; L. A. Ferguson, Chicago, and T. E. Murray, Brooklyn.

Among the papers read was one by Mr. E. A. Leslie on "The Development of Summer Lighting," which gave an account of the result of extending the service of the Brooklyn Edison Company to Coney Island. The project for this extension at first met with some opposition, but the result is indicated by the fact that the lighting load of Coney Island and other summer resorts to which the lines were subsequently extended, has brought up the load curve of the middle of the summer to an equality with that of the heaviest days of the winter. A most significant feature of the curve is that it shows that more machinery is required to handle the summer load than is required for the winter load. Aside from the influence of these extensions on the company's business, has been the effect in increasing the popularity of the summer resorts, the brilliancy of the lighting not only bringing greater crowds, but retaining them to a later hour in the night. Owing to the excellent results produced at Coney Island, the service has been extended to other resorts on Long Island, some of which undoubtedly owe their success to the fact that they were thus enabled to obtain the brilliant illumination which draws and holds the populace. With the paper was submitted a copy of the *Brooklyn Edison,* in which journal many views are given, showing how the old Coney Island has been transformed through the introduction of the Edison lighting service.

With the title "Overhead Pole Line Construction and Operation for Central Stations," Mr. A. H. Manwaring and Mr. J. T. Hutchinson read a paper giving the latest practice in overhead and pole line construction. Specifications are included for poles and cross arms for various kinds of service, illustrations of types being included. The subject is covered under the heads of poles, junction poles, cross arms, braces, pins, insulators, lightning arresters, fuse boxes, location and insulation of transformers on pole lines, location and construction of main or trunk lines, grounding of secondaries, complaints and rules. The paper advises that all secondary mains supplied by transformers should have the neutral of the three-wire system or one wire of the two-wire system grounded, the object being to prevent high-tension current from reaching the secondary wires. No wires smaller in size than No. 6 B. & S. gauge should be used for either primary or secondary work, and no fuse box or transformer should be placed upon a junction pole or arc lamp pole, except where absolutely necessary. Poles should be spaced from 40 to 45 yards apart, depending on circumstances, and in long lines every tenth pole should be guyed, the wire being carried from the top of one pole and about six feet from the base of the next. Iron poles, generally speaking, should be avoided on account of the liability of shock to linemen working on live wires. Poles of southern cedar lack mechanical strength and pine poles are short-lived, chestnut poles being preferable to either.

Mr. E. W. Lloyd, read a paper entitled "Purchased Electric Power in Factories," in which detailed information is given for determining the cost of power in the case of a customer who is thinking of replacing steam by electric power. For this purpose a tabulation is offered, and in another table are given the costs as determined in the case of a machine, carpenter and pattern shop, and a foundry. It is recommended that payment for motors be spread over long periods with good allowance in case they be taken back. The paper includes a table showing the annual variation in cost of current, caused by variation in percentage of efficiency of electric motors. In the case of a 10-hp motor, a one per cent. deficiency amounts to $11.65 per year, or $58.25 for 5 per cent. deficiency.

Mr. L. L. Eldon read a paper on the "Selection and Insulation of High-Tension Switch Apparatus," which subject was considered under the heads of switches, switchboard locations, bus-bar arrangement, generator switchboards, feeder switches, operating means for switches, construction and general recommendations. The author attaches a great importance to simplicity for a central station switchboard, and his recommendations are in line towards securing the greatest possible simplicity.

Bell Telephone Work in Wisconsin.

The Wisconsin Telephone Company, licensee of the Bell system in that State, is making extensive improvements throughout the entire system. The facilities of this company represent an investment of three and one-half million dollars, and one million more is provided for developments in 1903 and 1904. Thirty thousand subscribers and eight hundred toll stations are being furnished with service. Over twenty thousand miles of toll circuits are in operation within the State, exclusive of the interstate connections with the American Telephone-Telegraph Company.

A handsome new office and exchange building has recently been completed by the company in the city of Eau Claire, which is admirably arranged to suit the needs of the rapidly growing business. The first floor contains, on one side of the entrance hall, a public lobby, and connected with this a general office and the local manager's office. On the opposite side of the hall is the general office of the division superintendent and his private office. In the rear part of the first floor is the apparatus room, in which the underground cables enter through a terminal room in the basement. The entire second floor contains retiring and locker rooms for the operators and the main operating room, in which the very latest type of common battery board, of 2,000-circuit capacity, is being installed, by the Western Electric Company, of Chicago. The work is rapidly progressing, and it is anticipated that the building will be occupied by September 25. The entire aerial plant will be practically rebuilt and approximately 35,000 ft. of cable will be employed in the work, exclusive of the 10,000 ft. employed in the underground work.

Improvements of the same kind are being made at Chippewa Falls and Stevens Point, as well as in other points throughout the State. Copper circuits are being added to the several existing toll line routes and new territory is being opened up from Ashland to Chippewa Falls and Eau Claire, along the Wisconsin Central Railroad, connecting all the intermediate towns, not at present enjoying long-distance facilities.

Old-Time Telegraphers.

The twenty-third annual reunion of the Old-Time Telegraphers and the Society of the United States Military Telegraph Corps will be held at Milwaukee, Wis., on September 23, 24 and 25. The headquarters will be at the St. Charles Hotel, but the meetings of the two bodies will be held in the rooms of the Merchants' and Manufacturers' Association in the University Building. The business meetings will be held during the morning of September 23. The rest of the time will be taken up by excursions, etc. On the evening of September 24 there will be a banquet at the Hotel Pfister, and on Friday the entertainment will consist of a street car ride to Whitefish Bay.

Militia Electricians at Fort Terry, N. Y.

During the recent mobilization of the militia at Fort Terry, N. Y., for instruction under the officers of the regular army, the Thirteenth Regiment, H. A., N. G. N. Y., formed a detachment of forty men for the purpose of drilling them in the installation, operation and maintenance of artillery electrical apparatus. Owing to the variety of devices and the extensive use of electricity in these works, a splendid opportunity for instruction presented itself to the personnel of the detachment, as well as an object lesson to the militia body and all interested in coast defence, of the importance of electricity in its relation to heavy artillery operations. The electrical outfit of the fort, consisting of several separate generating plants, with both steam and oil engines, and having storage batteries as auxiliaries, furnishes current for motors used in ammunition hoisting, searchlights, lighting gun batteries, lights for fire and battery commanders' stations, garrison lighting, lights for night range finding, telephones, telautographs, electric clocks, and the submarine mine service.

From the above it may be seen that in order to successfully operate a fort, skilled electricians are a necessary part of the force. The skill of the men must excell that required for similar work in civil pursuits; for, although the engineering conditions under which electricity is applied in the artillery service are practically the same as in ordinary life, the requirements are of necessity much more exacting and difficult.

The detachment consisted of men picked from the entire regiment with reference to their aptitude for electricity. The examination consisted of questions aimed at determining knowledge, experience and how acquired of steam boilers, steam engines, oil engines, dynamos, motors, storage batteries, searchlights, wiring, telephone switchboards, telephone instruments, telephone lines, electric bells and signals or any special experience a man may have had that would not come under these heads.

Previous to the arrival of the regiment at Fort Terry the only knowledge the detachment had of the purely military end of the subject was derived from correspondence in connection with the arrangements for the encampment and from Major Anderson's handbook for artillery electricians, which suggested a set of rules for the individual instruction and guidance of all concerned.

All operations were carried out with the idea that the men were already conversant with the fundamental principles of the subject. They were told they were expected to exercise every endeavor to acquire as much knowledge as possible of the fortification electrical equipment. It was not necessary to mention the important part it played in its defensive strength, for this was obvious.

From the experience gained at the encampment, the first experiment of the kind since the militia were reorganized, it seems where men have had such training in handling electrical machinery as naturally comes to those who follow electrical work as a vocation, it will be comparatively easy to organize them so as to be of valuable service to the regular establishment in any emergency calling into action the seacoast defences. As the electrical part of fortifications consists mainly of devices which have become standard in the industrial world very little training would be required to make the men efficient. In those cases where the electrical apparatus is purely military in character, for instance the submarine mine system, of which civilians are not likely to have much practical knowledge and less experience, if the men are thoroughly grounded in the underlying principles of the subject, the intricacies of such work can be quickly mastered.

If this country should find itself involved in a war with a first-class power the immediate execution of a large mass of electrical work would be an imperative necessity, especially in connection with the seacoast defences. A very large number of trained men would necessarily be required to execute such work promptly, and these men must be drawn either from the enlisted forces of the regular army or must be raised as volunteer troops after the emergency has arisen. Unfortunately for efficiency, the electrical corps of our army is entirely too small for the amount of work it has to do. Army officers are making efforts to improve this condition, and will probably succeed, but as it is not likely that any force such as would be required in time of war will ever be available from the regular army, it follows that the bulk of our electrical work will have to be done by the electrician volunteer. Any arrangement, resulting in the organization of skilled electricians who at a moment's notice may be called on for duty as an auxiliary to the regular army in case of need is an addition to the defensive strength of the country.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON LAND.—According to a recent dispatch from Boston, J. S. Stone, lecturer in the electrical department of the Massachusetts Institute of Technology, recently succeeded in sending wireless messages from Cambridge to Lynn, Mass., a distance of about twelve miles, under conditions that have hitherto been deemed impossible.

ELECTRICAL ENGINEERING IN THE NAVY.—According to the *New York Herald,* Secretary Moody is considering the abolishment of the Navy Bureau of Equipment, and the distribution of its present functions among the remaining bureaus. In this event electrical engineering would come under the cognizance of one of the engineering bureaus of the navy.

MOSQUITOES UNDER THE RAY.—It is stated from Newark, N. J., that Dr. Frank Irving, chief of the X-ray department of the Newark City Hospital, has exploded the story to the effect that the X-ray would slaughter mosquitoes and other insects, and as a result of which Dr. Irving has received a number of letters asking for information. The X-ray, the doctor says, has a tendency to make the insects sprightlier and more inclined to bite.

WIRELESS TELEGRAPHY IN THE BRITISH NAVY.—In Montreal a few days ago Signor Marconi stated to a newspaper representative that he had just signed a contract with the British Navy Department for the use of his system of wireless telegraphy on all the ships of the British navy. This contract gives him permission to use all the British coaling stations in all parts of the world for the erection of land stations. Signor Marconi is on his way to Ottawa to confer with the government in reference to the erection of stations in different parts of Canada for a land system of wireless telegraphy from the Atlantic to the Pacific.

HEAVY STORM IN ENGLAND.—An unusually severe storm swept over the English and Irish coasts last week Friday doing an immense amount of damage to telegraph lines. The Western Union and Direct United States Cable Companies, according to a cable dispatch, were heavy sufferers, the land lines connecting London with the two cable terminals being blown down. Communication by these routes was cut off for several hours. The Commercial Cable Company's service, it is stated, was not quite so badly impaired, and at no time, so New York authorities assert, was its business completely suspended.

MILAN TRANSPORTATION EXHIBITION.—To celebrate the inauguration of the Simplon Pass tunnel an exhibition will be held in Milan in 1905 devoted to means of transportation. Of the ten divisions, one will comprise automobilism, another electric transportation and the third telegraphs and telephones. In the second mentioned the exhibits will be under the heads of generating plants, electric lines and equipment of roads, rolling stock, various applications of electric traction, literature relating to plans, designs and statistics. In the division of telegraphs and telephones, line and station material and apparatus will be exhibited, and an exhibition will also be made of the Marconi system of wireless telegraphy.

POWER FROM MISSISSIPPI.—It is announced from St. Louis that a dam across the Mississippi River is projected at the foot of Des Moines Rapids, at Keokuk, to produce 50,000 or 60,000 hp, which can be used for industrial purposes in all the cities and towns in that vicinity, and at the same time furnish deep water navigation for more than forty miles between Keokuk and Burlington. Engineers who have studied the plan regard it as not only feasible, but as promising great advantages to that section of the country. They predict the construction of other dams up and down the river for similar purposes in the future until the entire upper Mississippi is harnessed to electric plants and distributes its power over wires through the States which lie upon its banks.

WESTERN UNION AND PENNSYLVANIA.—It is stated that the Western Union Telegraph Company has a large force of engineers at work along the lines of the Pennsylvania Railroad Company east of Pittsburg marking the boundaries of the Pennsylvania's right-of-way and compiling an estimate of damages which the telegraph company sustained by the cutting down of its poles and wires some months ago by the railroad company. This information is to be the basis of a suit for heavy damages.

ACCIDENTS TO ELECTRICIANS.—Referring to a note which appeared in the issue of August 29, referring to accidents in Omaha to two electricians, the New Omaha Thomson-Houston Company writes us that as far as the accident occurring at its plant in which James Corr was injured, the item is correct, but that W. C. Gould, who was also injured, is an employee of the Omaha & Council Bluffs Street Railway Company, and while at work on the bridge between Omaha and Council Bluffs met with the accident noted.

THE NEW NIAGARA TUNNEL.—The shaft of the Toronto & Niagara Power Company, at Niagara Falls, has been sunk by A. C. Douglass to its full depth of about 140 ft., and a start of about 40 ft. made on the temporary tunnel in the direction of the line of the real power tunnel. The time consumed in sinking the shaft was little more than a month, and the work is regarded as a record-breaking feat. At the beginning many weeks were spent by Mr. Douglass in getting the cofferdams securely fixed in the loose rock and shale; but once ready for the start, with the bedrock exposed, the shaft went down with astonishing swiftness.

MARCONI'S TRANSATLANTIC WORK.—In a recent interview, Mr. Marconi stated that transatlantic communication by his system of wireless telegraphy would not be delayed beyond three months. Referring to his work in developing the system, he said that in the beginning he was willing that any scientists should examine his apparatus and should know the principles under which he had been operating, but persons have seen fit to take an unfair advantage of this to the extent of adopting his ideas, and it is now the policy of the company to observe the utmost secrecy about every improvement that has been adopted. His latest inventions, he stated, have not as yet been patented in the United States, and he could, therefore, give no description of them nor permit the public to know much about them until the patents have been obtained.

GATHMANN AIRSHIP.—The inventor of the Gathmann shell, which was tested at Sandy Hook, has invented a mechanical automobile airship. The ordinary electric fan, inverted so that the fan revolves horizontally, is the basis of Gathmann's idea. He has worked out a machine with huge fans, measuring 36 ft. from tip to tip, which revolve at a speed of 260 r.p.m., and, pushing the air from underneath, cause the car to rise from the earth and ascend into the air. Apparently either electricity or gasoline is used. The gasoline engines are planned to weigh 5 pounds per horse-power. As each engine has 500 hp, both, therefore, weigh 5,000 pounds. The inventor has provided that each horse-power shall have a lifting power of 33 pounds. Thus the two engines can carry together 33,000 pounds, or 22,000 pounds more than the actual weight of the ship.

BUILDING LONDON UNDERGROUND.—A cable dispatch from London of September 12 says: "Under the management of a young American named Huntingdon the London Metropolitan Railroad's new electric power station is raising its fine proportions at Neasden in rapid fashion. It is all being done with British workmen, too, whom Mr. Huntingdon says only need proper handling to work as hard as Americans. The bricklayers struck this week because Mr. Huntingdon demanded that they be at the top instead of the bottom of the ladder when the hooter gave the signal to begin work. Mr. Huntingdon offered them one cent per hour less if they preferred to begin at the bottom of the ladder and they accepted it. Men who thought it a good day's work to lay 500 bricks now lay 1,500 and even 2,000 under the stimulus of bonuses and with American labor-saving devices."

MONT BLANC TROLLEY.—M. H. Duportal, the French Inspector-Général des Ponts et Chaussées, has selected St. Gervais as the starting point for the railway which, it is hoped, in a few years, will reach the summit of Mont Blanc. The project is identified with the name of M. Vallot, the director of the Mont Blanc Observatory, and is for a railway starting from Les Houches. The idea seems to be to get the shortest possible and most sheltered line, enabling the summit to be reached in all seasons; and it is conceded that M. Vallot's survey is the best possible for the purpose. M. Duportal's scheme does not supersede its predecessor, however; rather it will prepare the way for it; and it has the great merit of serving the immediate and practical necessities of the district. The first section of the proposed electric line reaches the Aiguille du Gouter almost direct from Fayet by way of the Bionnassay Valley, which faces full south, and consequently is always free from snow early in the year, at any rate as far as the Tête Rousse. An open-air line by this route is, therefore, feasible; and this is important, as tourists naturally desire to see the perspectives of the mountains, which would be impossible if the line should be tunneled all the way.

AMERICAN ELECTROCHEMICAL SOCIETY.—The final programme of the meeting of the American Electrochemical Society to be held at Niagara September 17-19, comprises sixteen papers, as follows: "Some Theoretical Considerations of Resistance Furnaces," by F. A. Fitzgerald; "Manufacture of Ferro-Alloys in the Electric Furnace," by Geo. P. Scholl; "Advances in Electrometallurgy of Iron Production," by Marcus Ruthenburg; "An Experiment on the Electrolytic Determination of the Basicity of Acids," by I. J. Moltkehausen; "Electrolytic Copper Refining," by W. D. Bancroft, with written discussion by L. Addicks and B. Magnus; "Electrometallurgy of Gold," by W. H. Walker; "Efficiency of the Nickel-Plating Tank," by O. W. Brown; "A New Type of Electrolytic Cell," by P. G. Salom; "Electrolysis of Iodium Hydroxide by Alternating Current," by C. Hambuechen; "A Practical Utilization of the Passive State of Iron," by C. F. Burgess; "Electrolysis of Water," by Jos. W. Richards and W. S. Landis; "On the Supposed Electrolysis of Water Vapor," by F. Austin Lidbury; "Buthelot's Law Relative of E.M.F. of Cells Based on the Reciprocal Action of Saline Solutions and Soluble Electrolytes," by C. J. Reed; "The Thermo-Chemistry of the Dissociation Theory," by Jos. W. Richards; "Theoretical Properties of Free Ions in Solution," by E. F. Roeber; "Discussion of the Theory of Electrolytic Dissociation," opened by W. D. Bancroft. The programme also includes visits to Niagara power houses and electrochemical works, the usual sight-seeing trips and a dance and reception at the Cataract House. The local committee consists of Mr. E. G. Acheson, chairman, and Messrs. Collins, Hall, Acker, Haskell, Rankine, Mauran, Brindley and Lovejoy.

LETTER TO THE EDITORS.

The Nernst Lamp.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the claim that the introduction of the Nernst lamp in Buckingham Palace effected a saving of 50 per cent. in current over incandescent lamps, it may surprise a great many to know that the real efficiency of this lamp in practical service in this country is no greater than that of the ordinary incandescent lamp, and yet such is the fact. The candle-power value given to the Nernst lamp appears to be that obtained in a restricted zone beneath the lamp and is largely due to the reflected light from the porcelain frame of the lamp. Place an ordinary tin shade over a 16-cp, 50-watt incandescent lamp, and by the same method of measurement we get 50 cp with an efficiency of 1 watt per candle.

All this serves to show that the only true method of comparing different illuminants as to candle-power and efficiency is on a basis of spherical candle-power. When the Nernst lamp is so measured its efficiency in commercial service to-day will be found practically the same as the ordinary incandescent lamp. It is true that the Nernst lamp may be operated at a very high efficiency, and so also may the incandescent lamp, but the penalty of shortened life to the filament in both cases, makes it uncommercial to do so. It is also true that the Nernst glower operates at a higher temperature

than an incandescent lamp filament (rendered possible by the more refractory character of the Nernst glower material), but it does not follow therefrom that the efficiency of the Nernst lamp is higher.

A higher temperature does not mean a higher efficiency except where we compare the same kind of filament at different temperatures. Investigation shows that the Nernst lamp glower requires a much higher temperature to give equal efficiency with the carbon filament. The higher temperature, therefore, of the Nernst glower, far from making it of higher efficiency than the carbon filament, is necessary to bring it to the same efficiency, so that the advantage resulting from the greater refractoriness (that is, greater durability under higher temperatures) of the Nernst glower, is in a large measure lost by the fact that it requires to be burned at so much higher temperature in order to give the same efficiency. In contrast, and illustrating this point, we find the newly-discovered osmium filament to be far superior to the carbon filament, because it can be burned at a lower temperature for a given efficiency; and were the Nernst glower with its greater refractoriness possessed of the qualities of the osmium filament, it would be placed well in the lead of all other known filament materials because of the enormously high efficiency that it would have at its present high temperature.

It is possible, of course, that time and improvements may correct the shortcomings of the Nernst glower, but at present we must deal with the facts as they are. These facts are that the high efficiency credited to the Nernst lamp is not realized in commercial practice, and that the claims of the gain in efficiency over the incandescent lamp, as well as the methods of comparison, are misleading.

HARRISON, N. J. F. W. WILLCOX.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Measurement and Separation of the Losses of Asynchronous Polyphase Motors.—PEUKERT.—An article illustrated by tables and curves, in which the author gives the results of a number of measurements made with several motors, in order to determine whether the method given by Benischke, previously described in the Digest, gave only the frictional losses or a value including hysteresis losses in the rotor. Benischke had always used the same magnetic induction, and the author, therefore, wanted to determine whether the method is correct at different inductions. Instead of a Prony brake he used an electromagnetic or eddy-current brake. The slip of the motors was measured by the stroboscopical method. The author states that the results give an experimental proof of the fact, that in an induction motor at very small loads, the slip varies proportionally to the load, as the slip in such a motor, near to synchronism, is directly proportional to the resistance of the rotor and the power. He finds the friction and air losses are independent of the hysteresis loss in the rotor, and therefore concludes that the method of Benischke is suitable for the purpose. Only one motor of those with which he experimented, gave more work absorbed in friction with higher induction. The author explains this by an eccentricity of the rotor, on account of which an eccentric pull takes place due to the different densities of the lines of force, and he regards this as a simple means to test the centric disposition of the rotor by a determination of the friction losses. The experiments further show that the no-load slip becomes smaller with the increase of potential, the decrease of slip at no load being nearly inversely proportional to the square of the potential. When the friction losses are determined by this method, a further separation of the losses can be effected by subtracting them from the watt values with consideration of the copper losses, and thus obtaining the iron losses.—*Elek. Zeit.*, August 20.

Ohmic Loss in the Brushes of Direct-Current Dynamos.—LATOUR.—A mathematical article in which the author proposes to show that the ohmic loss in the brushes varies, for the same current strength, with the conditions of commutation in such a sense, that it decreases, becomes zero and becomes negative when the reverse e.m.f. increases, while it grows when the reverse e.m.f. decreases or changes its sign.—*L'Eclairage Elec.*, August 22.

REFERENCES.

Exact Diagram of the Asynchronous Polyphase Motor.—LEHMANN.—A mathematical article, illustrated by several large diagrams, which are calculated by the author. Curves of tests are also given, which were obtained with an Oerlikon motor of 360 hp at 6,000 volts and 25 cycles and a triphase 8-pole, 720-hp motor of 6,000 volts and 25 cycles.—*L'Eclairage Elec.*, August 22.

Testing of Electric Machines and Transformers.—DETTMAR.—The author gives a number of explanations, designed to clear up points in the standard rules adopted by the German Electrotechnical Society on the valuation and testing of electric machines and transformers.—*Elek. Zeit.*, August 20.

2,000-Kw Transformer.—A popular illustrated description of a 2,000-kw transformer built for the Pittsburg Reduction Company at Niagara Falls.—*Scient. Am.*, September 5.

POWER.

Steam and Electrically-Driven Auxiliaries.—TAITE AND DOWNE.—An abstract of a paper read before the Manchester Local Section of the I. E. E. on the comparison between steam and electrically-driven auxiliaries in central stations. The authors point out that the efficiency of a generating station as a whole depends to a very appreciable extent on the efficiency of the auxiliary plant, such as air pumps for condensers, cranes, feed pumps, mechanical stokers, economizers, coal elevators, ash conveyors and workshop. They state that during recent years it has become the practice to use electric motors almost exclusively for driving cranes, stokers, economizers, coal elevators, ash conveyors and the workshops, but that condenser air pumps and also feed-water pumps are still driven to a large extent by steam power. It is, however, becoming recognized that the loss from condensation in long steam pipes compares badly with the small amount of electric power absorbed in the cables. The authors give some interesting figures of the percentage of power absorbed by the electrically-driven auxiliaries in a large new central station. This was 8.3 to 6.5 per cent. of the total power generated, according to the state of the load factor and was distributed as follows: Condensing plant, 4.67 per cent.; boiler feed pumps, 1.18 per cent.; mechanical stokers, 0.37 per cent.; ash conveyor, 0.07 per cent.; economizer scrapers (1,600 pipes), 0.11 per cent.; coal elevators, 0.05 per cent., and workshop, 0.05 per cent. The power taken by the mechanical stokers represented 1.04 units per boiler-hour, while the economizers required 0.33 unit per hour for driving the scrapers for each battery of 400 pipes; the coal elevator absorbed 0.22 unit per ton of coal raised 40 ft. and deposited in the bunkers. The authors give a comparison carried out with steam and electrically-driven pumps, the average of the test for the steam pumps being 49.1 pounds of water delivered per pound of steam. An electrically-driven, 4,000-gallon pump furnished 108 to 147 pounds of water per pound of steam. Where any electrically-driven auxiliary plant is extensively adopted, the authors consider that a battery of accumulators is a practical necessity, as in the event of a total break-down of the generating plant from any cause, the supply of water to the boilers and the lighting of the works would not be interrupted. The authors then deal with the condensing plant and give figures obtained in practical running with single-phase, alternating-current motors driving centrifugal pumps for raising water for a Koerting evaporative condenser.—Lond. *Elec.*, August 21.

Electrical Pumps.—An illustrated note on a recent installation at Sydney, Australia, of a 500-hp engine and dynamo, and a 345-hp motor direct-coupled to a high-lift pump, which is designed to deliver 2,800 gallons of water per minute to a height of 265 ft. The engine is of the double-acting, compound-condensing type; the compound-wound, eight-pole generator gives 500 amp. at 550 volts. The shunt

and series windings are wound on aluminum spools. The motor is of similar design, with only four poles. The voltage at the terminals is 500, and the speed is 720 r.p.m.—Lond. *Elec. Rev.*, August 21.

REFERENCES.

Electric Rock Drills.—Munby.—The author discusses the advantages of the electric drill as compared with the air drills, in doing the work cheaper, requiring less horse-power, occupying less floor space, having less weight, etc. The construction of the electrical drills is then briefly taken up, and the difficulties pointed out which are still experienced with them.—*Stevens Inst. Indicator*, July; reprinted in *Eng'ing News*, September 3.

Electric Power Appliances in the Mines of Europe.—Guarini.—A well-illustrated article. The author describes a number of installations in mines, dealing with pumping and ventilating machinery, the driving of drills and drilling machines, the electric firing of shots, locomotives and tramming, hauling and hoisting machinery and the applications of electricity to the treatment of the ore after extraction in stamp mills, crushers, screens, etc.—*Eng'ing Mag.*, September.

Electricity in Mines.—Campbell Futers.—The first part of an article, reviewing in a general way the conditions which have to be conformed to by electrical installations in mines.—Lond. *Elec. Rev.*, August 21.

Motor-Driven Machine Tools.—An illustrated article, describing some recent practice in the application of the electric drive to drilling machinery.—*Am. Eng. & Railroad Jour.*, September.

TRACTION.

Electric Railroads.—Bork.—An abstract of a paper read before the Verein fuer Eisenbahnkunde, Berlin. The author gives the results obtained on the experimental road Berlin-Lichterfelde, repeatedly noted in the Digest. The consumption was on an average 22 watt hours per ton kilometer in summer and 23.3 in winter. For 1 kilometer of feeder and return conductor the resistance was in the beginning 0.0449 ohms, which was afterwards brought down to 0.04 ohms. The smallest observed insulation resistance for 1 kilometer single track was 16,000 ohms, the average being 500,000 ohms; the insulation loss with 25 kilometer length and 700 volts pressure was therefore 0.035 amperes or 22.5 watts. The conductors, storage batteries and the electric train equipment has been satisfactory. The current collectors have come up to expectations. The construction of the motor cars has been satisfactory. The motors, which are directly on the axles, produced only an insignificant wear and tear of the wheel tires. There was less jarring in running and starting than with steam locomotives. Electric heating proved to be too costly; electric braking had to be abandoned also, as being no more effective and more expensive than air-braking. The electric lighting showed considerable variation in intensity when the train started and gas lighting has replaced it. The cost of running was found to be for 1,000 effective train kilometers $266.45, while for steam traction under the same circumstances it was $266.35. Steam is therefore only a trifle cheaper. As advantages of electric traction are cited the better and easier adaptability to the conditions of traffic, the doing-away with smoke and soot, the considerable increase of the adhesive weight, the greater acceleration in starting and the lesser wear and tear of the permanent way.—*Glaser's Annalen.*, No. 622; abstracted in *Dingler's Polyt. Jour.*, August 22.

Power Stations for Large City Roads.—An article giving a brief summary of the practice in power station construction, although not limited to those of recent construction. Three tables show, first, the total capacity of power stations supplying city lines, the total capacity per mile of track, the total capacity per car operated at times of greatest traffic, and the kilowatt-hours per car-mile for the last year. The second table gives statistics relating to the recent generating stations erected by the different companies. The third table gives particulars of some of the largest engines in use. Although direct current is used for the greater part of the power employed in these cities, alternating-current distribution is employed to a limited extent, and most of the companies are now introducing alternating-current distribution. Diagrams show plans of the stations. In the new stations, special precautions are being taken to procure the separation of boilers, generators and engines into groups, so that accidents to one group will not affect the others, both in the steam and the electrical portion of the equipment. The generators are usually of 5,000-kw or larger. Electrically operating steam valves are being introduced. Ample facilities are being supplied for storing coal and handling it rapidly. The stations are designed so that extensions can be made very easily.—*St. R'y. Jour.*, August 29.

Standara Overhead Construction in City Streets.—An illustrated article, giving particulars of the practice of fourteen prominent city railway companies in overhead construction, from which it appears that there are many points of difference. Centre pole construction has become practically obsolete for city work; the objections to its use are enumerated in detail. There has been an increase in the weight and strength of the poles and also in the insulation between the trolley wire and the pole. In some cities three insulators are used between a trolley wire and the steel pole. In Milwaukee, however, the insulation at the trolley hanger has been done away with and the company uses only two strain insulators in the span wire. This construction makes the span wire alive, but this has not much practical importance. Practice is fairly well divided between two-section steel poles and three-section steel poles. Aluminum for feeders is not used to any extent. Figure 8 trolley wire has not met with much favor, but some companies are using it with satisfaction. St. Louis uses wood entirely for trolley wire insulators.—*St. R'y. Jour.*, August 29.

The Third-Rail System.—Gould.—An article reviewing the advantages of the third rail system for the construction and operation of interurban railroads. The author states that a third rail distribution system having an equivalent copper cross sectional area about 10 per cent. greater than with trolley can be built for the same cost per mile, the estimate including the crossing cables and connectors. He then discussed the type of third rail and says that the standard T rail has many advantages over all the rest. The third rail should be built of as highly conductive material as is permissible, of soft steel rails containing a very low percentage of carbon, the conductivity of which to copper is as about 1 to 7.5, while it is as 1 to 12 with higher carbon track steel. The question of third rail insulators is then taken up and a type of insulator mentioned which the author has found satisfactory. Third rails, cables and contact shoes are also discussed.—*St. R'y. Jour.*, August 20.

Electric Trolley Omnibuses.—An illustrated note on recent German designs and equipments of electric trolley omnibuses. The line Kœnigswald-Dresden is described, which has a double trolley wire, 30 cm. apart, one of them acting as positive and the other as negative conductor. The current collector, which is of a peculiar construction for preventing the trolley carriage from coming off the wire, is illustrated. It has four wheels, two of which rest on the positive and two on the negative wire. Omnibus and trolley carriage are electrically-connected by a flexible two-core cable, which is fastened to the pole on the car by means of a plug arrangement, which when two cars pass each other are simply exchanged, thus avoiding the necessity of having passing places. The length of the cable may be varied to suit requirements when passing other vehicles. The cars, of 2,850 kg. weight, are driven by two series motors of 15 B.hp maximum output, the consumption of energy, when the roads were dry and hard, being given as varying from 130 to 220 watt-hours per ton-mile, the former figure relating to level roads and the latter to gradients of 1 : 25. The cost of the overhead construction per mile is given as $2,000 to $2,800, and the cost of upkeep of the omnibuses at about 1 cent per mile. A short description of the Biela line is also given.—Lond. *Elec.*, August 21.

London United Electric Tramways.—A long, illustrated, descriptive article, dealing in detail with the Chiswick power station. This station contains two vertical cross-compound engines, each coupled to two 250-kw traction generators, one on each side of the fly-wheel. The generators are eight-pole machines, giving 500 amp. at 500 to 550 volts. There is also a 500-kw, three-phase alternator driven by an engine of the same size as above, giving 98 amp. per phase, at 5,000 volts, 25 cycles, and two 100-kw, 5,000-volt, three-phase alternators, coupled to two cross-compound vertical engines. The auxiliary plant comprises one 500-kw rotary converter, supplied with three-phase current by six 100-kw static transformers, and two negative boosters, 15 kw, giving 300 amp. at 50 volts on the generator side and driven by direct-coupled 500-volt motors. The generator field is excited by the current passing through the positive feeder of the district to which the negative cable of the booster is connected. The switchboard connections are illustrated. From the power station three-phase current at 5,000 volts is supplied to the sub-stations over three-core, lead-covered, paper-insulated cables laid in stoneware

conduits. The equipment of the sub-stations is briefly described. A diagram of the car controller connections and the car wiring is given.—Lond. *Elec. Eng.*, August 21.

Fonda, Johnstown & Gloversville Railway.—An illustrated description. The equipment of the new power station at Tribes Hill on the Mohawk River, one of the largest and most up-to-date interurban stations in this part of the country, consists of three engines, of the vertical cross-compound condensing type, developing 1,700 hp at 94 r.p.m. The generating station contains three main units of 1,000 kw each. Three sub-stations are located about ten miles apart. The high-tension line voltage chosen is 13,220 volts. One of the special features of the transmission system is the line between the generating station and the Amsterdam sub-station, which is in operation all day for railway and all night for lighting service. On this account the use of four transmission wires for a three-phase circuit was adopted, one of the four being a spare line with suitable knife switches at each end, for insuring continuous service.—*St. R'y Jour.*, August 29.

REFERENCES.

Modern Electric Railway Repair Shop Methods.—McCULLOCH.—The author discusses in detail the results secured in the repair shops of the Chicago City Railway. A statement is given of the machine tools used in these car houses, and the number of men employed with their duties. A table shows the classification of the operating expense accounts used in charging up shop time; another shows the division of the pay roll for the year 1902, according to occupation. It is interesting to note that the machine shop, car repairing and painting departments are about equal and are the largest items, being each more than 15 per cent. of the total. Other tables give the labor accounts for the shop and car houses, an itemization of the repair accounts, and the cost of performing some of the usual operations in the repair shop. He then gives some conclusions deduced from the practice followed in Chicago. He dwells on the importance of the standardization of apparatus. He believes it advisable only for the largest companies to attempt to manufacture apparatus for their own use. He then sums up what he considers the eleven important requirements in repair shop practice.—*St. R'y Jour.*, August 29.

Intramural Railway for the St. Louis Exposition.—WESTON.—An article containing a discussion of the original design of this railway, with a detailed statement of the proposed equipment and cost.—*St. R'y Rev.*, August 20.

Electric Railways in Europe.—A note reviewing the situation in Switzerland, Sweden and especially Germany. Special attention is drawn to several projects for the application of the Langen system of suspended electric railways, repeatedly noted in the Digest.—Lond. *Elec. Rev.*, August 14.

Automatic Coupling for Electric Railways.—An illustrated article, describing a new coupling designed by Mr. Westinghouse.—Lond. *Elec.*, August 21.

Standard Tramway Rules.—An article giving the most important provisions for "British Standard Tramway Rails and Fishplates," just issued by the Engineering Standards Committee.—Lond. *Elec.*, August 21.

Closing of Railroad Compartment Doors by Electricity.—VITOUX.—An illustrated article, containing a description of the Gime system of simultaneously closing all compartment doors on a train by electricity to prevent accidents.—*L'Eclairage Elec.*, August 15.

WIRES, WIRING AND CONDUITS.

Aluminum Conductors for Electric Transmission Lines.—ADAMS.—A popular article, in which the author compares aluminum with copper as regards its mechanical qualities, and discusses the conditions under which it can replace copper for transmission lines. Attention is drawn to the fact that on account of the larger diameter of the aluminum wires for a given current, the inductance is less than with copper wires. The loss of energy is, therefore, decreased, and the radius of transmission for large powers extended.—*Eng'ing Mag.*, September.

REFERENCES.

Locating Faults in Cables.—NORTHRUP.—An article describing two methods for locating faults in cables; the first is for the case that at least one good wire is available and the second when two good wires can be had.—*Elec. Rev.*, August 29.

Tests on Broken Cables.—RAYMOND-BARKER.—An article in the first part of which the authors point out various inconsistencies in the localization formulas given by several text-books. In the second part he gives a synopsis of localization formulas with uniform nomenclature, exemplified by the calculation of several problems.—Lond. *Elec. Rev.*, August 14 and 21.

ELECTRO-PHYSICS AND MAGNETISM.

Production of Helium from Radium.—RAMSAY AND SODDY.—A paper presented before the Royal Society, England. The authors conveyed the maximum amount of the emanation obtained from 50 mgms. of radium bromide by means of oxygen into a U tube cooled in liquid air, and the latter was then extracted by the pump. It was then washed out with a little fresh oxygen, which was again pumped off. The vacuum tube sealed on to the U tube, after removing the liquid air, showed no trace of helium. After standing for four days the helium spectrum appeared and the characteristic lines were observed identical in position with those of a helium tube thrown into the field of vision at the same time.—Reprinted in *Scien. Am. Suppl.*, September 5.

Method of Showing Penetrating Powers of Radium Rays.—BLACK.—An article in which the author describes a simple method for showing the great penetrating powers of certain radium rays. His arrangement consisted of two large Leyden jars, which had their interior coatings joined to the two sides of a Wimshurst machine, while their exterior coatings were joined to two small exactly similar spark-gaps arranged in parallel, to form alternative paths for the secondary discharge when the primary discharge took place on the machine. The secondary discharge will then pass at the gap which is exposed to the radioactive substance. The author has shown by this arrangement that 1 cgm. of radium bromide sends some rays through 8.5 cm. of lead. The presence of 1 cgm. of radium bromide even at a distance of 2 meters, may be detected definitely. To obtain these results the terminals at the spark-gaps ought to be small spheres about 1 or 2 cm. diameter, the gaps should be small and carefully shielded from all discharge of the machine. Thick lead shields, about 25 cm. thick, should be arranged to hinder any action of the radium on the gap which is not exposed to the radiation, and the Leyden jars should be of considerable capacity. He gives a table containing the results of some experiments, and shows that the radioactivity, induced by radium, produces some penetrating rays. After the radium bromide had been in an ebonite box for 18 hours, when the empty box was put on a sheet of zinc 0.5 mm. thick, which was placed over one of the gaps, the sparks passed readily through that gap.—Lond. *Elec.*, August 21.

Ionization in Air at Different Temperatures and Pressures.—PATTERSON.—The author gives the results of his investigations with description and diagrammatic sketch of the apparatus used by him. The results show that the ionization varied but slightly with the temperature (pressure constant) up to 450° C., but above this it increased very rapidly, due to ions being given off by the walls of the vessel, and the current being much greater when the cylinder was charged negative than when positive. The observations were carried up to a temperature of 520° C. The author also measured the ionization of the air at pressures varying from 765 to 27 mm. of mercury, and of hydrogen varying from 116 to 790 mm. of mercury. The results indicate that the current varies very slowly with the pressure down to 130 mm., and below 80 mm. the current is proportional to the pressure, while above 300 mm. the current is almost independent of the pressure. In hydrogen the current varies rapidly with the pressure, but not proportionally. The author attributes this partly to the hydrogen not being pure, and as the vessel was not quite air-tight there would be a greater proportion of air at the lower pressures than at the higher. The average of a large number of observations gave to the author 61 as the number of ions produced per c. cm. per second in the iron cylinder, which he used for the experiments, 3.4×10 to the $^{-10}$th power E. S. units as the charge on one ion, the volume of the cylinder being 12,800 c. cm. Wilson found 36, Rutherford 27 and Harms 53 to 63, the difference being most probably due to the different materials used by these investigators.—*Phil. Mag.*, August.

Rotation of Liquids in the Magnetic Field.—DRUDE.—The author made some further experiments on the rotation of liquids in a magnetic field, in connection with the results obtained by Urbasch, previously noted in the Digest. He carefully poured a layer of water

on sulphuric acid contained in a glass vessel, and on bringing the north pole of an electromagnet with a strong magnetic field about ½ cm. over the liquid, he obtained a rotation of the latter. At the wall of the vessel the liquid rotated counter clockwise, but when the vessel was heated around the rim the sense of rotation became reversed. He attributes the result to thermoelectric currents between the dilute and the concentrated liquids, when the temperature of the diffusion layer is not constant, which currents produce the rotation in the magnetic field. He concludes that a mixture of diffusing liquids will only in that case rotate in a magnetic field, when the phenomenon of diffusion is accompanied by an electric current, due to thermal differences or other reasons.—*Zeit. f. Electrochem.*, August 13.

Theory of the Coherer.—Huth.—An article containing a description of the author's experiments on the action of coherers composed of nickel filings subjected to the influence of a direct current. The filings were kept in constant motion by tapping the coherer. The dielectric was air and paraffin oil. The coherers showed in both cases the phenomenon of fatigue, which proves that this phenomenon also takes place with direct current, which has been denied by others. The paraffin oil coherer showed an automatic regeneration after 12 hours' rest. The author explains the function of the dielectric in the coherer effect, as follows: The electric waves, or the constant differences of potential acting at the coherer electrodes, the magnitude of which is increased gradually, produce an ionization of the dielectric and, therefore, its higher conductivity. The forces necessary for this are relatively small, owing to the smallness of the insulating layers. After the dielectric strength of the intervening medium is destroyed, an equalization of the potentials at the coherer electrodes takes place, which is accompanied, in consequence of the comparatively large resistance to be overcome thereby, by mechanical and thermal effects, and which breaks through the oxidized layer and welds the particles to each other. This explanation accounts for the phenomena without assuming the existence of sparks, as has been done by others.—*Phys. Zeit.*, August 15.

Properties of Periodic Currents of any Wave Form.—Swyngedauw.—A highly mathematical article in which the author extends the properties of sinusoidal energy currents and wattless currents to periodic currents of any wave form. He deduces that the law of Kirchhoff applies at every instant to the energy currents as well as to the wattless currents, which arrive at or depart from the two points of intersection between which there are several circuits. He then takes up Boucherot's theorem for sine currents, viz.: "In a network of alternating-current circuits, comprising neither collectors, turning commutators or resistances varying during the period, the sum of the magnetizing powers is zero, as well as the sum of the real powers." The author arrives at the conclusion that it is possible to apply the general propositions obtained for sine currents to the energy currents and the wattless currents of any wave form.—*L'Eclairage Elec.*, August 15.

Assymmetry of the Mercury Break.—Ives.—An article describing experiments which show that the capacity of the shunted condenser necessary to stop the sparking at the break of an inductive circuit, depends upon the direction in which the current is flowing through the break. The least amount of capacity which must be inserted in shunt around the break to reduce the spark from a large to a small one, was shown to be much greater when the breaking pole was connected to the negative side of the battery than when connected to the positive side. In the author's experiments the break was produced by an amalgamated copper wire 1 mm. in diameter, dipped by hand in and out of a small test tube containing mercury covered with water. The phenomenon also appeared when the mercury was not covered with water, and then the wire was of iron or platinum. Curves plotted from the observations are given. The author thinks that this remarkable assymmetry may be due to some selective action of the mercury vapor generated when the spark passes, of the same nature as in the recently-discovered Cooper Hewitt effect, or it may possibly be due to some capacity effect, such as is found in the Wehnelt interrupter.—*Phys. Rev.*, September.

REFERENCE.

Specific Resistance of Non-Metallic Conductors of the First Class.—Ferchland.—The author gives the results of an investigation of the specific electrical resistance of non-metallic conductors of the first class and especially peroxide of lead. He obtained the peroxide by electrolysis and subjected it to compression. The decrease of resistance with increasing pressure was measured. The results obtained are given.—*Zeit. f. Elektrochem.*, August 13.

Electro-Chemistry and Batteries.

Electrolysis with Alternating Currents.—Le Blanc.—A paper read before the recent International Congress of Chemistry at Berlin. The author first discusses the electrolysis of a sodium hyposulphite solution between cadmium electrodes, for the purpose of making sulphide of cadmium. He found that with 1,000 reversals per minute and a current density of 4.6 amp. per sq. dm. nearly no yield is obtained. With a lesser number of changes the yield increases, but it reaches only about 75 per cent. with one reversal per minute, and this only when the solution is stirred very briskly. He deduces from these observations that the sulphide of cadmium is reduced cathodically, and that at a low number of reversals the yield is only reached by removing the sulphide from the cathode by stirring. The author then carried out experiments with copper electrodes in potassium cyanide solutions, in order to arrive at some idea of reaction velocities, based upon the idea that if at a certain number of current reversals the copper electrodes in potassium cyanide solution were dissolved according to Faraday's law, that the time during one current impulse was sufficient for the accomplishment of the reaction of combination of copper with cyanogen; if, on the other hand, no copper was dissolved, the time was not sufficient for the reaction to take place. He found that with a 4 normal potassium cyanide solution and 4.6 amp. per sq. dm. current density, 90 per cent. of the copper went into solutioin at 3,400 reversals of the current, 58 per cent. at 17,600 reversals, and 33 per cent. at 38,600 reversals. He concludes, therefore, that the velocity with which the copper ions react is very great, but still conceivable; and he finds by extrapolation that with 80,000 reversals per minute no copper would go into solution. The velocity of reaction does not seem to be influenced to any extent by the temperature, as was shown by an experiment at 0° C.—*Zeit. f. Elektrochem.*, August 6.

Silicide of Ruthenium.—Moissan and Manchot.—A paper read before the French Academy of Sciences, describing the authors' method of preparation in the electric furnace of a new compound, silicide of ruthenium. It is obtained by acting with a current of 600 amp. at 120 volts for about two or three minutes on a mixture of powdered ruthenium and crystalline silicon, put into a carbon boat inside of a tube of the same substance. A well-fused metallic regulus is obtained, which when treated with various solvents, gives a residue of brilliant white crystals. The yield is about 80 per cent. of the ruthenium used.—*Comptes Rendues*, Tome 137, p. 229; abstracted in *L'Eclairage Elec.*, August 22.

Double-Carbide of Chromium and Tungsten.—Moissan and Kouznetzow.—The authors have obtained this new double carbide by heating in the electric furnace, in a carbon crucible, a mixture of 100 grams sesquioxide of chromium, 45 grams of tungstic acid and 30 grams petroleum coke or sugar carbon. The current must not be of too great intensity, 400 amp. at 75 volts for five minutes being sufficient. Another method of obtaining the double carbide consists in fusing in the electric furnace a mixture of metallic chromium, tungsten and a small quantity of sugar carbon in the presence of a large excess of copper, always avoiding as much as possible the carbon vapor of the arc. The mass is melted rapidly in a carbon crucible and the copper is maintained in ebullition for one to two minutes. After pulverizing and treating the regulus thus obtained with various solvents, small crystalline clusters of the double carbide are obtained.—*L'Eclairage Elec.*, August 22.

Leeds Copper Works.—A short description of the works and its installations for carrying out the Elmore electrolytic process for the manufacture of copper tubes. The plant is capable of turning out 75 tons per week. The depositing department contains 216 acid sulphate depositing tanks, in 24 lines of nine tanks, placed end to end. The copper used for depositing is 96 per cent. pure, and is treated for the removal of the arsenic and other impurities in three twelve-ton refining furnaces, from which it is cast into trough-shaped molds 13 ft. long, which form the anodes for the electrolytic bath. The mandrels, around which the copper is deposited, are turned by electric motors, and up to 4 in. diameter are made of brass, and above that of cast iron with brass ends. Before being used in the depositing tanks where the tubes are made, the mandrels are treated

in the alkaline electrolytic bath containing copper anodes, so that they become coated with a thin layer of copper. The tubes are formed in the acid sulphate solution, lead conductors bringing the current to the copper anodes, while the mandrel cathodes are connected to the negative terminal by copper conductors and flexible brushes. The tubes are withdrawn by revolving them between friction rollers after which the mandrel is withdrawn. Tubes up to 4 ft. diameter and 13 ft. length can be produced in this way. There are four pairs of 250-hp, cross-compound condensing Corliss engines for driving the depositing dynamos, each pair driving a 1,700-kw, direct-current dynamo. For power purposes there are three pairs of 400-hp engines of a similar nature, each pair driving a 425-hp dynamo.—Lond. *Eng'ing*, August 14.

Voltametric Balance.—PFANHAUSER.—Descriptions of some improvements in his voltametric balance, which is intended for use in electroplating baths, and serves to control the amount of deposit obtained on the articles to be plated.—*Zeit. f. Elektrochem.*, August 13.

Manufacture of Electric Accumulators.—A reprint of the regulations issued by the British Home Office, applying to all factories where electric accumulators are manufactured, prescribing the sanitary conditions to which employer and employees have to conform. The regulations will come in force October 1, 1903.—Lond. *Elec.*, August 21.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct-Registering Ohmmeter.—SACK.—An article giving an illustrated description of an instrument for practical use in which the resistance values can be read off directly. The apparatus consists essentially of a milliamperemeter with a moving coil, connected in series with several storage cells and the unknown resistance to be measured. The apparatus has a scale with approximately even divisions, and the pointer is adjusted so that it rests at the high end of the scale when the instrument is not in use. When no resistance is in the circuit, only the battery and instrument being included, the pointer should be at zero, thus showing its maximum deflection. As resistance is inserted the deflection becomes smaller and, therefore, the reading from the zero point becomes greater. Suitable provision is made to prevent a too strong recoil of the pointer and a possible damage to the instrument, by connecting a resistance in shunt, which is inserted automatically, when the contact key which is pressed down for the purpose of taking readings, is released. An arrangement is also included which permits changing the magnetic field of the instrument 15 per cent., thus adapting it to the varying voltages of the storage battery. Before using the instrument, it is tested with the battery and the instrument only in the circuit, in which case the pointer should be deflected to the zero point; if it does not do so, the magnetic shunt is varied by turning a screw head, until this position is obtained. Contacts are arranged for using the instrument for several ranges of measurements.—*Elek. Zeit.*, August 20.

MISCELLANEOUS.

REFERENCES.

Annual Meeting of the German Electrotechnical Society.—A long report, with details of the reports of the various committees and the discussions of the papers read before the meeting. The following rules and regulations are given in full: namely, on the construction and maintenance of wooden poles for high-voltage installations; on the construction and testing of installation material, such as box cut-outs, plug contacts, plug fuses, lamp holders with and without switch; on the testing of iron sheets; on the valuation and testing of electric machines and transformers, comprising the output rise of temperature, insulation, overload, efficiency and methods of determining it, and tabulated values for the frequency, number of revolutions and potential; on standard values for copper; on standards for wires and cables of various construction for high and low pressures; on the protection of metallic pipe lines against the earth currents of electric railroads.—*Elek. Zeit.*, August 13 and 20.

Necessary Practical Safeguards Against Fires Caused by Lightning.—HANDS.—An abstract of a paper read before the recent International Fire Prevention Congress in London. The author reviews the phenomenon of lightning and gives his views on the question of earthing the conductor. He draws attention to the fact that a side flash or spark will occur between the conductor which is struck and other metals sufficiently near it; the latter should, therefore, be at a safe distance or connections should be made to them. He then discusses the cases of failures of conductors. The conditions under which a maximum of safety can be obtained are discussed in conclusion.—Lond. *Elec. Rev.*, August 21.

Treatment of Malignant Diseases by Electrical Methods.—JONES.—A paper read before the British Medical Association, with discussion. It is devoted to the use of the X-rays for cancerous diseases and the proper way of procedure.—Lond. *Elec.*, August 21.

Electro-Magnetic Gun.—An illustrated description of a gun composed of a series of short coils in which the current is interrupted successively as the forward pole of the iron projectile has passed the coils.—*Elektroteknisk Tidsskrift;* abstracted in *L'Eclairage Elec.*, August 15.

Continental Electrical Engineering Industry.—An article discussing in a general way the financial situation of the principal German, Swiss and Russian enterprises, based upon their published annual reports.—Lond. *Elec. Rev.*, August 21.

New Books.

DIE TELEGRAPHIE OHNE DRAHT. By Augusto Righi and Bernhard Dessau. Braunschweig: Friedrich Vieweg & Son. 478 pages, 258 illustrations. Price, 13 marks.

This volume forms one of the most complete treatises on wireless telegraphy that has appeared. It is divided into four parts. The first part or chapter deals only with the general laws of electricity, and while apropos, of course, to the subject of wireless telegraphy, it is no more attractive than similar matter which may be found in hundreds of treatises on electricity. The second part is devoted to the earlier experiments in wireless signalling, particularly those of Hertz, whose researches it fully details. The latter portion of the second part is devoted particularly to radioconductors or conductors which are employed to emit energy in the form of Hertzian waves, and is a valuable collection of existing knowledge upon this subject.

The third part comprises matter bearing particularly upon wireless signalling. It details the various experiments which have been made with inductive systems such as that invented by Sir Wm. Preece, and with various attempts to telephone from moving trains. Then the various systems now specifically known as wireless telegraph methods are taken up and fully and completely illustrated. The volume is particularly valuable in containing detailed drawings of all of the circuits which have been employed, together with the designs used for the various coherers, induction coils and decohering apparatus.

The last chapter deals with such miscellaneous systems of signalling without wires as are comprised in the various photophonic experiments which are perhaps somewhat more interesting than practicable. The work is entirely descriptive in character and non-mathematical, but, as both a historical and descriptive account of the art of wireless signalling it is very complete.

DAS ELEKTRISCHE LIGHT UND DIE ELEKTRISCHE HEIZUNG. By Dr. Alfred Ritter v. Urbanitzky. Leipzig: A. Hartleben. 226 pages, 103 illustrations. Price, 4 marks.

This little pamphlet is a somewhat popular exposition of electric lighting and heating. It commences with a general description of the electric arc and the elementary principles of arc lighting. The effect of the magnet upon the arc is shown and data are given as to the temperatures of the carbons. A historical description of incandescent lighting follows which is chiefly interesting in presenting the various mechanical details of glow lamps. In order to be up to the times Mr. Cooper Hewitt's mercury arc experiments are briefly described. Next follows a chapter upon arc lamp mechanism that is somewhat trite in presenting for the reader's consideration the old Duboscq regulator and other antiquated types. In order to justify its title the last very short chapter gives a brief resumé of electric heating. The work is non-mathematic in character and popular in style.

KURZES LEHRNBUCH DER ELECTROTECHNIK. By Adolf Thomalen. Berlin: Julius Springer. 515 pages, 277 illustrations. Price, 12 marks.

A condensed manual of electrotechnics would be almost a literal translation of the title of this volume and expresses its purpose

perhaps better than a more elaborate description. It is not a pocket compendium of rules and tables like those of Foster, Monro and Jamieson, nor is it a general treatise on the laws of electricity, but it is something midway between the two that has no analogy in English literature. There are 19 parts or chapters, each of which is devoted to a particular branch of electrotechnics and is intended to be a working digest giving both the principles and data most frequently desired in relation to each of the topics. The first chapter touches only elementary principles, the second deals with the storage battery and the third with elements of magnetism. It is only when chapter IV is reached that the volume becomes interesting to any one but an elementary student of electricity, and excepting for the sake of completeness, the first three chapters might well have been omitted. In the succeeding ones, however, the book amply redeems itself, for in the following parts, describing the various forms of dynamo machines and in elucidating the principles which govern their operation and their design the book rises to a high level.

The author makes an exceedingly extensive use of vector diagrams, and his explanations are some of the most lucid that we have ever met with. The pages on polyphase systems will be a material aid to many students who have been perplexed at the voltage and current rules, which are here explained in the most satisfactory manner by the aid of diagrams which are novel in their arrangement. The latter part of the work is devoted to alternating-current motors and then closes with some pages upon vectorial algebra and an exceedingly complete table, embracing a very wide range of electrical equations. To the working electrician the volume will probably prove so valuable an aid that many American engineers will regret that it only appears in German.

Descriptive Geometry. With Numerous Problems and Practical Applications, and a Quarto Atlas of 18 Plates. By William S. Hall, C.E., E.M., M.S. New York: D. Van Nostrand Company. 76 pages and portfolio of 18 plates. Price, $3.50.

This is a well-arranged work on the subject and contains much instructive matter. The author quotes Auguste Comte to show that descriptive geometry is valuable, both for mental discipline and for its industrial utility. Perhaps the same may be said of some other branches of mathematics, but not in the same degree. For example, it is safe to say that most persons do not know that the form of the ordinary locomotive cow-catcher is a hyperbolic paraboloid, but that such is the case becomes apparent as soon as the method of construction is studied. A further study of the book shows that several other surfaces and curves of complex nature are used in the arts, some by design and some as accidental results.

A machinist of the more intelligent class knows that in turning a taper by the usual method he must keep the point of his tool on a level with the point of the lathe center—that is, the axis of the work—or the taper will be hollow instead of straight, but he does not know, unless he happens to be a mathematician, that when the tool is "off the center" he is turning a hyperboloid of revolution of one nappe. Descriptive geometry would tell him this; the information, however, would be of no importance to the ordinary workman, but the man who has work to lay out ought to know it. Descriptive geometry is a study of importance to all who aim at acquiring a technical education, and deserving of more attention than it receives in some courses. The work before us is a good exposition of the subject, considering the limitations of one small volume. It is not, of course, a complete treatise, but it gives a good deal of information on a wide range of subjects.

The Chemical Publishing Company, of Easton, Pa., will print English translations of the series of monographs on applied electrochemistry, written by authorities on the electrochemical industry, and edited by Victor Engelhardt, chief engineer of the Siemens-Halske Company, Vienna. So far the following volumes have been issued in the German language: "The Electrolysis of Water," by Victor Engelhardt; "The Electro-Metallurgy of Chromium," by Max Le Blanc; "The Arrangement of Electrochemical Laboratories," by H. Nissenson; "The Manufacture of Metallic Objects Electrolytically," by Dr. W. Pfanhauser; "The Electro-Metallurgy of Nickel," by Dr. W. Borchers. The translations will be made by Prof. J. W. Richards, of Lehigh University, president of the American Electrochemical Society.

Power Equipment of Portland Mill in Colorado Springs.

FIG. 1.—CHLORINATION MILL.

Large users of electric power in Colorado are the mills or plants for the reduction of the gold ore mined in the Cripple Creek and other mining districts of the State. There are three such mills in the immediate vicinity of Colorado Springs and the installation in the Portland chlorination mill may be taken as typical for a plant of that character. The mill is located on Bear Creek, about one mile west of Colorado Springs. It is owned by the Portland Gold Mining Company and is used for the reduction of the low-grade gold ore coming from the famous Portland mine at Victor, 45 miles distant. The ore is hauled to the mill over the line of the Colorado

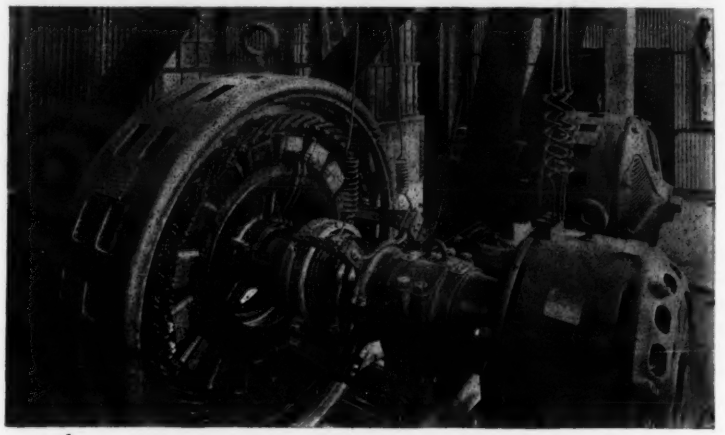


FIG. 2.—SYNCHRONOUS AND INDUCTION MOTORS.

Springs & Cripple Creek District Railway, whose track is seen in the accompanying general view of the works.

The present capacity of the mill is three 100-ton Pierce roasters,

FIG. 3.—SYNCHRONOUS AND INDUCTION MOTORS.

but another 100-ton roaster is about to be added. All the machinery in the mill is run by electric power, purchased from the Colorado Springs Light & Power Company. A six-mile transmission line carries the power from that company's steam power plant north of Colorado Springs, to a substantial brick sub-station building at the mill. Here the 6,200-volt, 60-cycle, three-phase current passes through oil-break switches to the high-potential switchboard. General Electric lightning arresters are used to protect the line. Four 250-kw General Electric oil-cooled transformers (one being held in reserve) step the potential down to 460 volts for the power work in the mill. Both primary and secondary circuits are delta-connected.

The three power panels of the low-potential gray marble switchboard each control two power circuits. On the center panel are an indicating wattmeter and an indicating voltmeter, while on each of the two outside panels is a recording wattmeter for registering the power of the main three-phase power circuit before it is distributed to the individual feeders.

There is a total motor installation of over 1,500 hp. With the exception of two revolving field synchronous motors and two variable-speed motors all the motors are three-phase induction

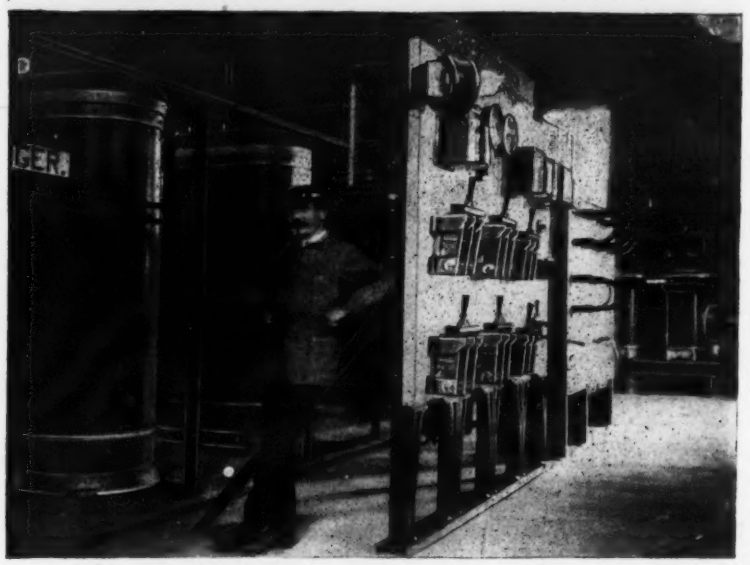


FIG. 4.—SWITCHBOARD, TRANSFORMER HOUSE.

type, and were all supplied by the Westinghouse Electric & Manufacturing Company. The motors operate on 440 volts at 7,200 alternations. In one of the accompanying illustrations are shown a 300-hp synchronous motor, the largest in the mill, and a 75-hp induction motor. The synchronous motor has mounted on its extended shaft a 25-hp induction starting motor. It is used to drive the rolls by means of a belted shaft, while the 75-hp machine drives in a similar manner the three 100-ton roasters. The other synchronous motor is of 200-hp capacity and is used to drive the chlorination barrels. For exciting the fields of the synchronous motors, two 115-volt direct-current generators driven by 15-hp induction motors are located in the sub-station.

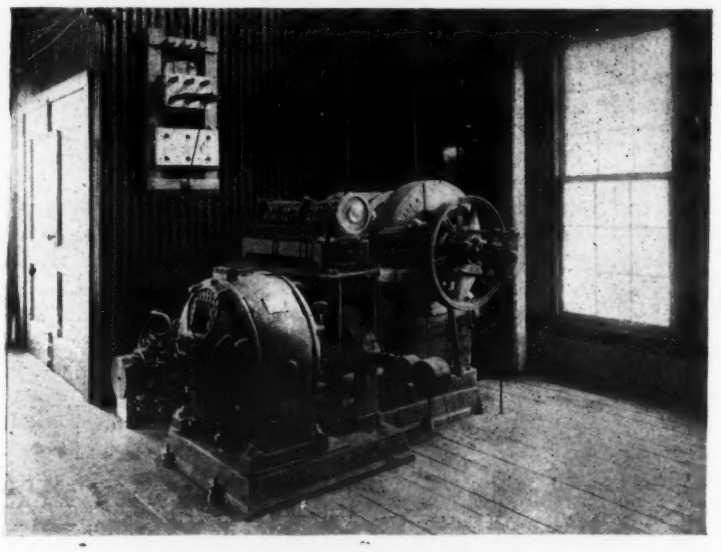


FIG. 5.—MOTOR ON FREIGHT ELEVATOR.

The other induction motors in the plant are distributed as follows: A 200-hp motor driving the crushing department; 40-hp driving the fans for cooling the hearths on the roasters; 75-hp for the fans in the barrel house; 75-hp for operating an air compressor; 75-hp for driving the concentrating tables; two 40-hp motors operating upright Deane pumps; 50-hp for driving the machine shop and carpenter and blacksmith shops; 10-hp for a roll in the melting room; 50-hp for rolls in the sampling department; 10-hp on the bedding floor for driving conveyors; 75-hp for dust-collector and screens. A 25-hp variable-speed motor is used for box car handling apparatus on a trestle. A 30-hp variable-speed motor has been used for operating a freight elevator at a speed of 300 ft. a minute, the equipment being of the latest Westinghouse pattern, with automatic elevator controller.

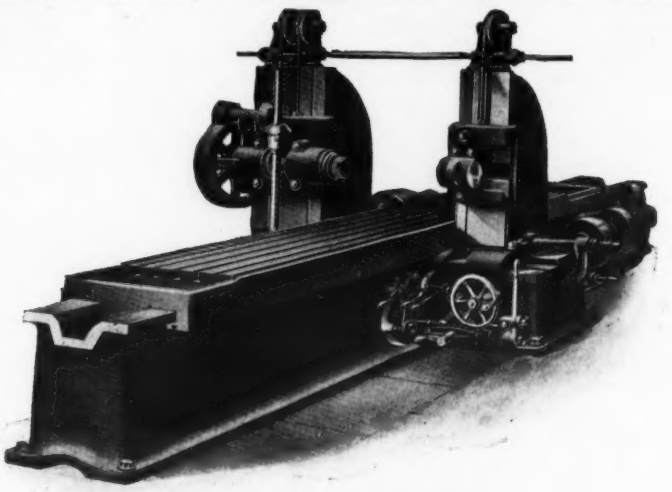
Water for the boilers and other purposes is obtained from Bear Creek, a short distance below the mill. There are three pumping stations, the largest one containing two Deane pumps driven by 75-hp induction motors. The other two stations are operated respectively by 40 and 15-hp motors.

For lighting the mill a separate 1,100-volt, single-phase circuit is used, this being split up into two 110-volt circuits through two 25-kw transformers connected in multiple. There are three incandescent circuits supplying about 500 lamps and one arc circuit carrying Manhattan enclosed arcs. Arc lighting has not proved a success in the mill, as the dust and gas affect the lamps so that they soon get out of order. The lighting circuits are controlled by one panel on the power switchboard.

The electrical plant has run continuously, or practically so, since it was started up over a year ago. When any shut-down has occurred, it has generally been on account of accident to the mill machinery rather than any fault of the electrical apparatus. The consumption of power varies from 5,000 to 6,000 kw-hours a day, the peak load being about 300 kw and the minimum load 150 kw. The sub-station and electrical equipment are under the management of S. J. Connolly.

Planer-Type Milling Machine.

The Brainard-Becker Milling Machine Company, Jamaica Plain Station, is introducing a new 10-ft. planer type milling machine, shown herewith. This machine is built from new designs and new patterns and is of very heavy construction for strength, rigidity and power, with special provisions for ease of operation and the demands of modern milling machine practice. The spindle is made of hammered crucible steel, 5 in. in diameter, has a threaded nose and runs in self-centering bronze boxes, with nut and check nut to compensate for wear. The spindle carrier is very heavy and is held firmly to the upright by long gibs. It is elevated by a screw with adjustable dials graduated to thousandths of an inch, and has a counterbalance for ease of operation. There are 20 changes of speed for the cutter spindle obtained by gearing in the main driving cone, operated by clutch and lever, so that all changes can be made instantly. The table is very heavy and is regularly built with five T slots lengthwise and an oil channel the full length and at each end. It travels on flat ways securely gibbed and has a quick return operated by power from a separate countershaft. It can also be moved by the usual hand wheel. The feed of the table



PLANER TYPE MILLING MACHINES.

is directly operated through gearing from the spindle at ratios of 13½ and 27 to 1 by 5-in. belt on a 5-step cone, the diameter of which is 23 in. on the largest step and 13 in. on the smallest, giving a range of feed through eight changes, from 3/64 to ⅜ in. These changes of feed can be made instantly by means of a lever, without stopping the machine. The head may be adjusted from either side of the machine, so that it is not necessary to take the cutters off the arbor in order to change their position in relation to the work. The bed extends to the floor and makes a solid foundation.

Evershed Testing Set.

It has come to be recognized that the requirements as to methods and apparatus for insulation testing work are different from those employed in the past for testing in connection with submarine cable and similar work. The apparatus illustrated in Fig. 2 and widely known in Europe as Evershed's testing set was designed to meet those requirements, and in the course of the past few years its specialized function have received very general recognition among electrical men all the world over.

The Evershed set is an adaptation of the two-coil ohmmeter combined with a portable hand dynamo yielding a continuous current at any voltage that may be desired. The electrical principle is indicated in Fig. 1. The current from the dynamo *D* divides at the ohmmeter into two parts, of which one flows through the pressure coil *P*, and constant resistance *R* and tends to turn the magnetized needle *N S* and index towards the infinity point on the scale, while the other fraction of the current traverses the windings of the current coil *M* and the leakage path *X* through the insulation which is under test.

When there is no leakage the current coil has no field and the needle is free to lie in the magnetic axis of the pressure coil. The index then stands at the last division on the scale, which is accordingly marked "infinity." If the insulation resistance is so low as to be negligible, the current flowing through the current coil will depend only on the volts and the resistance of the current coil itself. The current coil will now deflect the needle away from "infinity" to a position in which the turning moments of the two coils are balances. This point on the scale is marked "zero." Obviously, for any given resistance in the leakage path the index will come to rest at a definite point between zero and infinity. Moreover, if the resistance is constant and independent of the voltage, the position of the index will not be changed by increasing or decreasing the volts, for if the volts are doubled, for example, the currents in both coils will be doubled and their ratio remains unchanged. Hence the angular position of the needle and index indicate resistance quite apart from voltage.

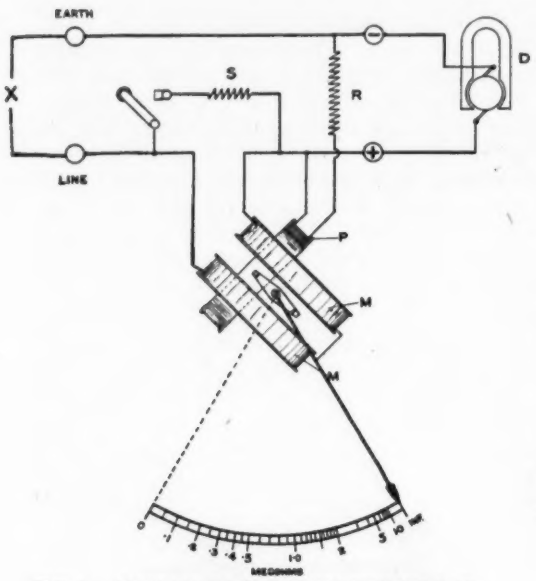


FIG. 1.—DIAGRAM ILLUSTRATING PRINCIPLE OF TESTING SET.

FIG. 2.—GENERAL VIEW OF TESTING SET.

It should be noticed here that this instrument is a true ohmmeter in that it directly indicates the value of the resistance under test by means of a pointer which ranges over a scale of ohms and megohms, just as an amperemeter indicates amperes, a voltmeter volts, and so on. The word ohmmeter is sometimes applied, quite illegitimately, to apparatus based upon the Wheatstone bridge principle; an application of the name which is entirely misleading, and about equivalent to calling a potentiometer a "voltmeter."

In the present and latest pattern of Evershed testing set, the hand dynamo is built after the fashion of a modern continuous current generator. It has a tunnel wound armature, a finely laminated core built from stampings of best iron of "transformer" quality, a special form of commutator with elastic roller brushes and roller bearings for the armature axle. It is driven by double gearing, all the gears having machine cut involute teeth. The winch handle is hinged so that it may be turned down into a recess in the box when not in use. A convenient flexible connector is provided for coupling the dynamo to the ohmmeter.

The ohmmeter has a very finely pivoted astatic needle system, magnetized by the dynamo current and, therefore, free from all the troubles incidental to permanently magnetized astatic needles. The needle system is automatically lifted off the jewel bearing and securely clamped by the action of shutting the lid of the box. The current coil is wound with an enormous number of turns of the finest wire so as to secure the maximum sensibility. A one-ninth shunt is provided so as to reduce the sensibility ten times when low insulation resistances are being tested. There are four terminals on the ohmmeter. Two of these serve for the connections to the dynamo, and the other two are marked "line" and "earth," respectively, and to these the circuit which is to be tested must be connected.

To use the apparatus successfully calls for no more than a hand to drive the dynamo and an eye to watch the index of the ohmmeter. There is not a single adjustment of any kind to be made beyond screwing two leveling on the ohmmeter until the bubble of a circular spirit level stands central. There are no calculations to be made, for the scale reads in megohms.

A complete insulation test may be had in less than a minute from the start, and this without any knowledge of scientific testing. An example drawn from every-day experience will best illustrate the utility and convenience of the apparatus. A shunt-motor armature has been rewound and replaced in the machine. While coupling up preparatory to running a bad leak to frame is felt. The shop testing set being at hand, the ohmmeter is coupled to one terminal of the motor and to the frame. Half a dozen turns of the hand dynamo are sufficient to show up an insulation resistance of about 16,000 ohms. On lifting the motor brushes the insulation runs up to several megohms, showing that the ground was not in the brush gear nor in the field windings. The "line" connection of the ohmmeter is now lifted on to the commutator and on turning the hand dynamo very slowly the ohmmeter reads about 30,000 ohms; on gradually speeding up the dynamo to a high voltage—150 volts or so—the insulation steadily falls to 12,000 ohms, a result that pointed clearly to moisture in the freshly varnished armature coils. This test, as actually made, occupied less than two minutes, and in that time the leak had been located, its extent measured and its cause ascertained with a certainty that enabled the motor to be started at once on load, in full confidence that the leak was not a local defect on the point of breaking down, but a widely diffused leakage due to traces of moisture which would dry out as the armature warmed up.

The Evershed testing set is being manufactured in this country by Messrs. Queen & Co., of Philadelphia and New York, who have placed on the market a handy series of ohmmeters ranging up to 50 megohms, together with a standard line of hand dynamos wound for 100, 200, 500 and 1,000 volts.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculative conditions were dull and prices had a lower tendency, notwithstanding the easier conditions of the money market and the favorable crop outlook. The only conspicuous movement of the week was the heavy decline in United States Steel shares, which appeared to be mainly due to manipulative efforts to depress that security. The common stock fell to 20⅛, which is the lowest figure on record. This extreme drop naturally exercised an unfavorable influence on the market at large. Apart from the drop in steel shares, the market was practically featureless. Metropolitan Securities and Metropolitan Street Railway were marked up on very limited transactions, whereas Brooklyn Rapid Transit was raided similarly with the steel stocks and sold off. Brooklyn Rapid Transit closed at 40½, being ¼ point above the lowest of the week—the highest being 45¼. Thirty-nine thousand two hundred and twenty five shares of this stock were sold. Metropolitan closed at 114¼, which is a net gain of 1½ points, the sale aggregating 5,120 shares. General Electric fell to 162½ and closed at that figure, which represents a net loss of ½ point, the sales aggregating 1,150 shares. The two issues of Westinghouse showed decided weakness, both closing with net losses of 4 points, the quotation of the common being 166 and that of the preferred 171. Western Union made a net gain of ⅜, closing at 83½. American Telegraph & Cable closed at 18½, being a net gain of 1¾ points. Following are the closing quotations of September 15:

NEW YORK.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
American Tel. & Cable	79	78¾	General Electric	162	160
American Tel. & Tel.	132	130	Hudson River Tel.	..	..
American Dist. Tel.	24	24	Metropolitan St. Ry.	112¼	113¾
Brooklyn Rapid Transit	43¾	38¾	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	145	N. Y. & N. J. Tel.	..	..
Electric Boat	13	13	Marconi Tel.	1⅜	1⅛
Electric Boat pfd.	38	38	Western Union Tel.	83	83
Electric Lead Reduction.	1¼	1¼	Westinghouse com.	165	155
Electric Vehicle.	4½	5¼	Westinghouse pfd.	170	160
Electric Vehicle pfd.	7½	8			

BOSTON.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
American Tel. & Tel	132⅛	131	Western Tel. & Tel. pfd.	81¼	80
Cumberland Telephone	..	..	Mexican Telephone	1⅜	1¼
Edison Elec. Illum.	..	..	New England Telephone	124	124
General Electric	..	..	Mass. Elec. Ry.	21¼	20
Western Tel. & Tel.	13	12	Mass. Elec. Ry. pfd.	79½	78½

PHILADELPHIA.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
American Railways	..	44¼	Phila. Traction	95⅛	95⅛
Elec. Storage Battery	56¼	55	Phila. Electric	6¼	6
Elec. Storage Battery pfd.	56¼	55	Phila. Rapid Trans.	..	13¾
Elec. Co. of America.	8⅝	8¼			

CHICAGO.

	Sept. 8	Sept. 15		Sept. 8	Sept. 15
Central Union Tel.	..	..	National Carbon pfd.	88	89
Chicago Edison	..	..	Metropolitan Elev. com.	..	..
Chicago City Ry.	170	170	Union Traction	4¼	5
Chicago Tel. Co.	..	..	Union Traction pfd.	..	30
National Carbon	20	20			

BROOKLYN RAPID TRANSIT.—The annual report of the Brooklyn Rapid Transit Company for the year ended June 30 shows a surplus for the year of $796,783—or about 1¾ per cent. on the capital stock. Gross earnings were $13,280,321 and net $5,349,242—an increase in the former case of $769,699 and in the latter of $1,022,517. The net returns would have been greater had it not been for unusual expenditures under the heading "operation of power plant," these including $109,337 paid for hired power and $283,979 increase in the cost of coal due to the coal strike. The mileage of the system is 251 miles, of which 242 is double-track. In addition there are 35 miles of siding and turn-outs, making a total trackage of 530 miles. The passenger earnings are divided as follows: Surface, $9,284,157, an increase of $234,928; elevated and bridge, $3,802,683, an increase of $530,647. During the year there was added to car equipment 120 open elevated cars, 16 open surface cars, 34 combination surface cars, 10 freight gondola cars and 2 snowplows. In his report President Winter says, among other things: "The new central power station is progressing toward completion and is expected to be fully in operation with its equipment of eight 4,000-hp engines in the spring of 1904. The causes of extraordinary delays in work of this character during the year last past, and still existing, are too well known to need explanation. Four of the eight engines are in service and work is generally well advanced, with the exception of boiler and steam fitting work, which is much behind the time set for completion. There were installed and are in operation in the eastern power station one new 4,000-hp engine, with 2,700-kw generator, and at various sub-stations six 1,000-kw rotary converters and eighteen static transformers. Sub-stations in Essex Street and Halsey Street were completed and put in operation, and Sands Street sub-station well advanced."

BELL TELEPHONE OUTLOOK.—The following is from a Boston financial source: "The fact that New England investors have been obliged to take practically all of the $22,000,000 new stock of the American Telephone & Telegraph Company after having absorbed about $15,000,000 of the stock from New York holders, including the Morgan holdings, makes the present market for American Telephone shares somewhat limited. The American Telephone & Telegraph Company is now passing through the most prosperous period in its history and the aggressive and efficient management of Mr. F. P. Fish has permeated every department of the business. It is unfortunate that the stock should sell at the lowest price for years, but it is generally recognized that present prices are the result of general financial conditions entirely foreign to intrinsic values. That the stock sold at 127, however, was no surprise to some leading interests in the company. When the question of the new stock issue came before the board of directors there was considerable difference of opinion among the members of the board as to the advisability of the issue this summer, some taking the position that as the company had $8,000,000 of cash on hand it could have borrowed sufficient money for construction needs to have carried it through this year, while other members took the position that the Telephone Company should divorce itself from stock market conditions. At that time one of the influential directors stated to the board that if a stock issue was made this year the stock would sell at 125, and it did decline from above 150 to 127. Leading interests in the Telephone Company, however, were never stronger in their faith in the property than at the present. The stock at 133 returns 5.3 per cent. upon the investment."

CONDUIT ENTERPRISES EMBARRASSED.—A number of companies engaged in the clay brick and conduit industry have been embarrassed by the financial difficulties of Mr. Raymond C. Penfield, of New York City. The companies are the Brooklyn Brick & Sewer Pipe Company, the Standard Fire-Proofing Company, the Great Eastern Clay Manufacturing Company, the Standard Vitrified Conduit Company, the National Clay Manufacturing Company, and the Manhattan Brick & Terra Cotta Company. It has been ascertained that, in addition to other liabilities, Mr. Penfield put out notes to the extent of about $1,200,000 for the purpose of raising "working capital," and no provision was ready to meet them when they began falling due on September 8. All the companies here and three companies in Cleveland are involved as endorsers of the notes. Several of the concerns are doing a large business and the assets are considerable. The Continental Trust Company has been appointed receiver. We are glad to learn from the Standard Conduit Company that its business is intrinsically in splendid condition, and President Barnard informs us that it will go right forward in spite of these difficulties arising outside its own direct affairs.

WESTERN UNION FINANCES.—The Western Union Telegraph Company issues the usual statement for the quarter ended September 30, 1903 (partly estimated):

	1903.	1902.	1901.	1900.
Net revenue	$2,400,000	$2,247,174	$1,949,316	$1,705,756
Bond interest	286,300	252,550	239,040	239,040
Balance	$2,113,700	$1,994,624	$1,710,276	$1,466,716
Dividends	1,217,015	1,217,010	1,217,005	1,217,001
Surplus	$896,685	$777,614	$493,271	$249,715
Previous surplus	13,019,724	10,751,003	9,319,285	8,352,450
Total surplus	$13,916,409	$11,528,617	$9,812,556	$8,602,165

The actual returns for the June 30 quarter were: Net revenue, $2,007,698; bond interest, $286,300; balance, $1,721,398; dividends, $1,217,015; surplus, $504,383; previous surplus, $12,515,341; total surplus, $13,019,724.

GENERAL ELECTRIC ACTIVITY.—A financial dispatch from Boston says: "While there has been a falling off in the booking of new business by the General Electric Company, leading officials of that company look upon the depression as but temporary. They think it is due to monetary conditions rather than to timidity on the part of consumers fearing a general depression in business. They believe that with the crop movement well under way monetary conditions will ease and business conditions improve. The General Electric Company is at the present time handling a record-breaking

business. In July and August the company did a gross business of over $7,500,000. In the last annual report of the General Electric Company it was shown that net manufacturing profits amounted to 20 per cent. of the gross. Upon this basis the General Electric Company must have done a net business in July and August of about $1,500,000, not including income from securities it owns."

DIVIDENDS.—The directors of the United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent. on the capital stock, payable October 1. The Savannah Electric Company has declared a regular semi-annual dividend of 3 per cent. on the preferred stock, payable October 1, to stockholders of record September 17. The Seattle Electric Company has declared a regular semi-annual dividend of 3 per cent. on the preferred stock to stockholders of record September 17. Directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable October 15. The General Electric Company has declared a dividend of $2 per share, payable October 15. The Commercial Cable Company has declared a quarterly dividend of 2 per cent. payable October 1.

MISSOURI EDISON.—The Missouri Edison, of St. Louis, and Union Electric Companies have been consolidated, taking the name of the former. The capital is $10,000,000. An injunction to prevent the merger was served too late.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a general improvement in trade conditions, yet some irregularity still exists. A better feeling prevails with reference to the outlook for the corn crop, the conditions in most States having improved during the last week. There is less activity in the East, as indicated by advices from that section, but there are signs of improvement in the cotton mill situation. In the West lumber and building materials of all kinds are active and firm, but at the East the resumption of building operations at strike centers has not been sufficient to keep those markets strong. Iron trade is rather pessimistic, buyers persisting in holding off, but the reported declines in Northern and Western irons are largely sympathetic—the result of the reported additional cuts in the Southern product. Other metals, notably tin and copper, have eased off. In copper there was nothing of interest, the business transactions being of rather ordinary proportions. The ruling quotations were 13⅜ to 13⅝c. for Lake, 13¼ to 13½c. for electrolytic, 12⅝ to 12⅞c. for casting stock. Railway earnings continue good, the increases for August being fully 8 per cent. over the best previous years. *Bradstreet's* notes that collections showed a slight improvement, the result probably of the crops moving to market. Owing to the lateness of the crops, there is little complaint of traffic congestion. The business failures remain about normal, as indicated by *Bradstreet's* figures. The number for the week ending September 10 aggregated 165, against 162 the week previous, and 197 the corresponding week last year.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, through its Eastern District office, Keystone Telephone Building, Philadelphia, Mr. Paul W. Bossart, manager, reports recent sales as follows: Dallas, Pa., 200-line switchboard and telephones; Tunkhannock, Pa., 100-line switchboard and telephones; New Albany, Pa., 25-line switchboard and telephones; Waterside, Pa., 25-line switchboard and telephones; Alexandria, Va., 350-line switchboard and telephones; Frenchtown, N. J., 150-line switchboard and telephones; Perth Amboy, N. J., 200-line switchboard and telephones; Lambertville, N. J., 150-line switchboard and telephones; Flemington, N. J., 150-line switchboard and telephones; New Egypt, N. J., 100-line switchboard and telephones; New Lisbon, N. J., 100-line switchboard and telephones. In addition to the foregoing list of sales, the Kellogg Company has just secured orders for substantial additions to the "Main" and "Race" exchanges of the Keystone Telephone Company in Philadelphia, amounting to five sections for each exchange, making the total present equipment of each of the above exchanges 5,200 lines. The Kellogg Switchboard & Supply Company has also been awarded the contract for a switchboard and telephones for Linton, Ind. The contract calls for an 800-line switchboard with ultimate capacity of 3,000, and telephones. The directors of the New Home Company, of Linton, compose part of the board of directors of the Knox County Telephone Company, of Vincennes, Ind. On account of the satisfactory results from Vincennes they ordered an exact duplicate of the board for Linton.

WESTINGHOUSE ELECTRIC SALES DEPARTMENT.—The New York offices of the sales organization of the Westinghouse Electric & Manufacturing Company, consisting of the New York Sales Department, Department "I," the Export Department and the General Agent's office, have been removed to the new Hanover Bank Building, corner of Nassau and Pine Streets. The new offices occupy the entire seventeenth floor of this building, one of the finest and best equipped office buildings in the country, and where every facility will be provided, both for the representatives of the company and for the public with whom they do business. The mail address of the several departments of the Sales Organization in New York will be No. 11 Pine Street. The telephone number, 6131 Cortlandt, remains unchanged. The executive, financial and stock transfer offices will remain on the fourth floor of the Equitable Building. The present organization of the Westinghouse Electric & Manufacturing Company has been quartered in the Equitable Building since 1889, but the rapid and material increase of business has made the above move necessary.

CHICAGO CONTRACT FOR TROLLEY CARS.—The contracts for 100 new cars at a cost of $493,500 have been let by the receivers for the Union Traction Company. General Manager Roach states that he will at once apply to the city for permits to substitute the overhead trolley for cables in certain streets on the north and west sides. Without the new trolleys the new cars would be nearly useless, and out of this application for change of power may come a clash between the city and Judge Grosscup, involving the interpretation of the "99-year act." The new cars contracted for are to be 40 ft. long, equipped with air brakes, reversible seats, large windows, which practically make them open cars in the summer, and push buttons to signal conductors. They are to cost $4,935 each, the contracts for the cars being let to the St. Louis Car Company for $2,535 each, and for the electric motors to the General Electric Company for $2,400 each equipment. They are to be delivered in Chicago before December 31.

NOBLESVILLE, IND., POWER PLANT.—The Noblesville (Ind.) Hydraulic Company is carrying out an important enterprise in power transmission and is already making contracts for apparatus. It is utilizing a fall on the White River and creating a reservoir of about 100 acres. The power thus developed will operate six turbines of 350 hp each, for which an order has already been given. The National Electric Company, of Milwaukee, has the contract for generators, etc., at $18,500 for the initial equipment. It is expected to use the plant ten months in the year, and to furnish current for lighting as well as for industrial purposes. The transmission is about two miles.

ELECTRIC CAR TRUCKS.—Mr. R. R. Frazier, United States Consul at Copenhagen, Denmark, writes as follows: "A well-known firm of agents in Copenhagen desire to correspond with a firm in the United States who are in position to furnish trucks for street cars and steam cars in a country foreign to both Denmark and the United States, where the government will undertake the construction of new lines of railway, electric and steam. Trucks for passenger cars will be required for the electric lines and trucks for passenger and freight cars for the steam railways. Letters forwarded to this office in reply to the above request will be promptly delivered."

BALL ENGINE ORDERS.—The Smith Premier Typewriter Company, of Syracuse, N. Y., has recently purchased a 500-hp cross-compound engine, direct-connected to an alternator from the Ball Engine Company, Erie, Pa. The power plant for the First National Bank Building, of Chicago, is now being installed. The engines, of which there are four, are of the vertical cross-compound type, arranged for direct-connection to generators, and are 300 hp each. The engines were built by the Ball Engine Company.

ELECTRIC TRAIN LIGHTING.—It is stated that electric lighting is to be substituted for gas on all passenger coaches on the Pennsylvania Railroad. Every passenger coach now being built in the shops of the company in Philadelphia, Jersey City, Altoona and Pittsburg is wired in addition to having the illuminating gas installation. Several of the Pennsylvania coaches have storage battery lighting now.

ELECTRIC POWER IN BOSTON.—The Boston Edison Company reports 1,838 power contracts, representing 13,693 hp connected and 9,129 hp demanded. There are also on the system motors equal to 6,107 hp on "commercial rates." The motors are employed on an endless variety of service.

J. W. O'BRIEN & CO., Journal Building, Boston, are installing the underground work at the Woman's Insane Hospital, Dorchester, Mass. They have also been awarded the contract for underground installation in conduit and cable by the Auxiliary Fire Alarm Company, Boston.

General News.

THE TELEPHONE.

SONORA, CAL.—The Sonora Telephone Company has been incorporated with a capital stock of $50,000. Among the directors is W. E. Bristol.

ATLANTA, GA.—An independent long-distance telephone line from Atlanta to Asheville, N. C., is to be constructed at once by the Gainesville Co-operative Telephone & Telegraph Company.

BRADFORD, ILL.—The Milo & Bradford Telephone Company has increased its capital stock from $5,000 to $20,000.

DAHLGREN, ILL.—The Dahlgren People's Telephone Company has increased its capital from $2,500 to $5,000.

WARREN, ILL.—The Pitcher Telephone Company, with a capital stock of $7,500, has been incorporated by L. B. Pitcher and others.

STREATOR, ILL.—The Independent Telephone Company of this city will extend its lines to Aurora and Ransom, and will spend about $30,000 in extending and improving the lines in this city.

WABASH, IND.—The franchise of the Central Union Telephone Company in this city recently expired, and no renewal has so far been asked.

INDIANAPOLIS, IND.—A summary of the tax returns for telephone companies show a valuation of $11,966,172 in the state. This is exclusive of real estate and office fixtures. The tax board at its final session sustained the appeals of the South Bend Home Telephone Company and reduced its assessment from $100 to $90 a mile; the Steuben County Farmers' Telephone Company from $30 to $20 a mile; the Home Telephone Company of Elkhart from $170 to $160 per mile. A reduction was also made in the assessment of the Merchants' Mutual Telephone Company of Michigan City, and of the Delaware & Madison Counties Telephone Company from $100 to $80 a mile. The appeal of the Citizens' Company of Kokomo; the Crown Point Telephone Company; the United States Telephone Company; the Chicago Telephone Company and the Home Telephone Company of Crawfordsville were not sustained.

BURLINGTON, IA.—The Iowa Telephone Company will erect a line direct from this city to Omaha.

WHAT CHEER, IA.—The What Cheer Telephone Company has been incorporated with a capital stock of $5,000.

DES MOINES, IA.—The New Montana Telephone Company has been incorporated with a capital stock of $100,000.

DES MOINES, IA.—The Des Moines Mutual Telephone Company directors have decided to purchase a switchboard costing $95,000.

DECORAH, IA.—The Summer Telephone Company, capitalized at $30,000, and owning about 150 miles of lines and large exchanges at New Hampton and West Union, besides several smaller ones, will pass under the control of Vic. Stevens, who controls the Standard, Interstate and Dubuque lines. Mr. Stevens bought of the two chief stockholders of the company $18,000 worth of the stock, paying eighty cents on the dollar.

COUNCIL BLUFFS, IA.—The Nebraska (Bell) Telephone Company has a large force of workmen constructing the underground conduit system and expects to have the work completed by the latter part of the month. Plans have been made for a new exchange building and contracts for its construction will probably be let shortly. A new switchboard will be installed with a capacity of 1,200 lines. The company expects to expend about $135,000 for the proposed improvements. The central energy system will be adopted.

WHITEWATER, KAN.—The Whitewater Telephone Company has been incorporated with a capital stock of $2,500 to establish a local exchange here.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company has absorbed the Kansas Long Distance Telephone & Telegraph Company, which tried unsuccessfully to get a franchise in Topeka a year ago, and is now building an extension in North Topeka to connect with a new Kansas City toll line which will be in operation in a few months.

MAYBURG, KY.—A telephone line will be built between Whitesburg and Stonega, Va.

OWENSBORO, KY.—The Rural Home Telephone Company, of Davies County has been formed; capital $25,000. Directors: H. K. Cole and others.

MIER, MEX.—A telephone line is being constructed between this place and the town of Doctor Arroyo.

HOMER, MICH.—The Homer Telephone Company has been incorporated with $15,000 capital. The principal stockholders are B. F. Woodbury, Raymond C. Smith, E. D. Woodbury and Roy D. Gardner. Extensive improvements are contemplated in the plant involving the addition of about fifteen miles of rural lines and the use of metallic circuits throughout.

DETROIT, MICH.—It is announced that the plant of the People's Telephone Company, representing an investment of approximately $400,000, has been sold to a syndicate associated with the Stromberg-Carlson Company, now operating independent telephone systems throughout the country. The new organization embraces six prominent men in other cities as follows: Eugene H. Satterlee, president of the Rochester Home Telephone Company, Rochester, N. Y.; Thomas W. Finucan, general manager of the Stromberg-Carlson Telephone Manufacturing Company; Alfred Stromberg, president of the Stromberg-Carlson Telephone Manufacturing Company of Chicago; Arnold Kalman, capitalist, of St. Paul, Minn., and John J. Heim, president of the Kansas City Home Telephone Company, of Kansas City, Mo. The company has petitioned the Common Council for a new franchise for the purpose of operating its lines in the city and connecting with other independent telephone lines throughout the state.

WRIGHTSTOWN, MINN.—The Hewitt Wrightstown Telephone Company has been incorporated and will extend its line in several directions.

GLENCOE, MINN.—The McLeod County Telephone Company has been incorporated with a capital stock of $50,000. J. J. Greaves and E. B. Greaves are among the directors.

ST. LOUIS, MO.—The Kinloch Telephone Company has closed negotiations for a right of way for a line from Alton to Springfield, having procured franchises in almost every town along the way.

ST. LOUIS, MO.—By a deal which has been closed between the Kinloch Long Distance Telephone Company of Missouri and the Buffum Telephone Company of Louisiana, Mo., St. Louis will receive long distance connections with a large number of northeast Missouri towns which have not been in reach of telephone communications before. Before the end of September the Kinloch Company will have its wires into Jefferson City, and the extension will be pushed West and South as rapidly as possible until Kansas City, Joplin and Carthage are reached. Wherever it is practicable, connections are being made with local branches.

BEAVER CROSSING, NEB.—The Beaver Crossing Telephone Company has changed its name to the Seward County Telephone Company. It has a capital stock of $50,000 and the incorporators are C. W. Doty, H. C. Johnson and others.

FILLEY, NEB.—The Home Independent Telephone Company has been incorporated with a capital stock of $3,000. The incorporators are Charles Hughes, S. R. Smith, C. R. Burbank, Edward Hughes and J. A. Barnard, all residents of Filley.

TAMORA, NEB.—The People's Mutual Telephone Company has made great progress since its incorporation in February. It has arranged with the Stromberg-Carlson Company to connect with Seward, where the plant will cost not less than $15,000 and will be ready for service about the first of January, 1904.

FREMONT, NEB.—The Fremont Telephone Company has asked the City Council, through a communication from the Commercial Club Committee, for permission to raise the company's rates, stating that it is not possible for it to continue business at the present rates for service. The Council appointed a committee of three to investigate the matter and report.

NEWARK, N. J.—The Central New Jersey Telephone Company has applied to the Springfield Township Committee for a franchise to operate a telephone line in that place. Similar applications have been made in the counties of Union, Morris, Hunterdon and Middlesex. The representatives of the company, which is a new concern, claim that the rates will be one-half the patrons of the present company are now paying.

TRENTON, N. J.—Articles were filed with the Secretary of State on Sept. 5 merging the American Telephone & Telegraph Company of New Jersey, the New York & Philadelphia Telephone & Telegraph Company and the Midland Telephone & Telegraph Company into the American Telephone & Telegraph Company of New Jersey. The new company has an authorized capital of $130,000 and is a long distance branch of the Bell telephone system. The officers are Edward J. Hall, Morris Township, president; Edward P. Meaney, Newark, vice-president; Melville Egleston, Elizabeth, secretary; James P. Vail, New York, treasurer.

WATERLOO, N. Y.—The Home Telephone Company will extend its lines to Bridgeport.

HEMPSTEAD, L. I., N. Y.—All the wires of the New York and New Jersey Telephone Company, from the city line of Queens, and along Fulton Avenue to the Bethpage Turnpike in the village of Hempstead and so on to Babylon Turnpike, will be placed underground. A subway is now being built.

FRANKFORT, OHIO.—The Hickman Telephone Company has been incorporated with a capital stock of $5,000.

JOHNSTOWN, OHIO.—The Johnstown & Croton Telephone Company has increased its capital stock from $30,000 to $50,000.

CINCINNATI, OHIO.—The Butler County Western Telephone Company has increased its capital stock from $5,000 to $12,000.

PEEBLES, OHIO.—The Adams County Telephone Company has been incorporated, capital $10,000. Directors: E. Humphreys and others.

LIGHTSVILLE, OHIO.—The Lightsville Telephone Company has been organized by J. L. String and others, the capital stock being $5,000.

GERMANTOWN, OHIO.—The Germantown Independent Telephone Company, Germantown, has increased its capital from $2,500 to $10,000.

NEW LEXINGTON, OHIO.—The Sunday Creek Valley Telephone Company has been incorporated with a capital stock of $50,000. Mr. DesAntle was chosen president.

FORTVILLE, OHIO.—The Fortville Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are P. A. Randall, F. E. Brown, J. H. Haskell.

CINCINNATI, OHIO.—W. Gilbert Thompson, of Lebanon, a heavy stockholder in independent telephone companies in Ohio, says that an independent telephone system will be in operation in Cincinnati as soon as mechanical arrangements can be completed.

SPRINGFIELD, OHIO.—The Central Union Telephone Company will install an exchange at Yellow Springs. Heretofore that village has been served exclusively by the Springfield & Xenia Telephone Company.

ST. MARY'S, OHIO.—The St. Mary's Telephone Company has adopted the automatic telephone system for its new plant, now in course of construction. As far as known Dayton and Columbus are the only two cities in the state where the automatic system is being installed.

MEDFORD, OKLA.—The Oklahoma & Kansas Telephone Company has increased its capital stock to $300,000.

SOUTH SHORE, S. D.—W. C. Cralle has been granted a franchise to install a local telephone system here.

PLATTE, S. D.—The Charles Mix County Telephone Company has been formed to take over the local mutual exchange and improve it.

MEHERRIN, VA.—The Lunenburg Telephone Company has been organized here with Mr. A. M. Bruce, president; E. P. Wallace, vice-president; M. E. Gee, secretary; E. T. Staples, treasurer; E. A. Owen, manager.

CLARKSBURG, W. VA.—The Consolidated Telephone Company of Clarksburg and Fairmont has decided to extend its lines in Wheeling, Uniontown and Pittsburg, and will at once install a long-distance service.

ALMA CENTER, WIS.—The Central Wisconsin Telephone Company will build a new line to Fairchild at once.

MAIDEN ROCK, WIS.—The Maiden Rock & Esdaile Telephone Company has completed its organization and elected officers as follows: President, Beverly White; secretary, Otto Holverson; treasurer, G. Bangton.

WAUSAU, WIS.—The Wausau Telephone Company will modernize its plant and improve it generally.

AVOCA, WIS.—The Avoca Telephone Company has sold its lines to the Union Consolidated Telephone Company and gave possession Sept. 1. This company owns and controls over 500 miles of lines and is acquiring more by buying and building.

LARAMIE, WYO.—A telephone line will be built to connect Laramie and Hanna. It will be about 75 miles long and run via Rock River. A large number of ranches will be connected by the line.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The South Yuba Water Company, which controls the Central California Electric Company, operating three electric power stations for transmission of electricity to Sacramento and other points, has purchased of the Pioneer Pulp Company a large additional water supply. The Towle & Bros. Company also sold its share of the property, which consists of the large lakes of the Pulp Company in Lake Valley, in Six Mile Valley and near the Alta station. Also the water rights and canals from the north fork of the American River, Canyon Creek and Little Bear River. The South Yuba Water Company, which already had one of the largest water systems in California, will now have an increased supply of power water for the plants in Placer County. Plans were recently announced for a large bond issue to provide money to extend the electric power and water system. The Van Norden Trust Company of New York will take the bonds. Dr. Charles Van Norden, of Sacramento, is manager of the Central California Electric Company. The South Yuba Company can use its water several times over by running it through electric power plants and then utilizing it for irrigating and furnishing power water for mining plants.

SANTIAGO, CUBA.—Eduardo J. Chibas, Enramadas baja 14, Santiago, has organized a syndicate to build a central lighting plant.

WASHINGTON, D. C.—Gen. Oliver, Acting Secretary of War, has issued a revocable license to the Great Falls Power Company to construct a dam across the Potomac River at Great Falls, to connect with the government dam at that point near the Maryland shore.

HIGH FALLS, GA.—S. Grantland, president of the Towaliga Falls Power Company, states that improvements are contemplated to the extent of about $300,000. W. C. Whitner, Richmond, Va., is engineer in charge.

COLUMBUS, GA.—The Rankin Realty Company, recently incorporated with a capital of $150,000, will erect an electric plant to furnish light, power, etc.

HONOLULU, H. T.—An electric lighting plant will be installed in Honolulu, H. I., and operated in connection with a new ice making plant by the City Market Company, which has been incorporated by Wong Leong and other Oriental business men.

EAST ST. LOUIS. ILL.—At a meeting of the stockholders of the Citizens' Electric Light & Power Company of East St. Louis, it was decided to spend $50,000 in improving the present plant.

CRAWFORDSVILLE, IND.—At the first meeting of the new board of electric light trustees the rates were fixed as follows: City street lighting $66 per light per annum; commercial rate 12½ cents per kw-hour. The street lighting rate is an advance of $6 per year over the old; the commercial rate is the same. The board discussed ways and means whereby the plant might be placed on a paying basis. Superintendent Thomas has resigned and his successor will be selected from applicants passing the highest examination. The questions will be prepared by a competent electrician or professor of an electrical school.

MADRID, IA.—It is reported that the Madrid Light & Power Company intends erecting an addition to its power house.

DES MOINES, IA.—It is stated that the Edison Light Company proposes to install an automatic stoker and a chain grate at the power station; also erect a 200-foot steel smokestack, brick lined; extend the power dam 400 feet; install six new steel boilers of 420-hp each. Cost, complete, $60,000.

COLDWELL, KY.—The Young Electric & Gas Company, of Coldwell, has been incorporated; capital $100,000. Incorporators: E. Young, John C. Gates and M. J. Groom.

SPRINGFIELD, MASS.—We are informed that the Boston & Albany R. R. intends installing an electric power plant in its West Springfield shops. A. Ames, Jr., is electrical engineer.

PORTLAND, ME.—The Boston Phoenix Lighting Company, of Portland, has been incorporated to make and deal in gas and electric appliances; capital $200,000, of which nothing is paid in. President, C. M. Drummond; treasurer, W. G. Chapman. Directors: C. M. Drummond, W. G. Chapman and J. H. Drummond, Jr., of Portland; Chas. W. Hulman and B. J. Noyes, of Boston, Mass.

BUCHANAN, MICH.—Mayor Geo. H. Black is reported interested in the installing of a municipal plant.

LAKE CITY, MICH.—Chas. Ostrander has secured a 10-year franchise to install an electric light plant here.

WADENA, MINN.—It is stated that the Council is considering the installing of meters for its electric light consumers.

STILLWATER, MINN.—The Stillwater Gas & Electric Light Company, according to reports, contemplates issuing $350,000 bonds to improve the local plant and to bring power from Apple River Falls.

TAYLORS FALLS, MINN.—It is stated that the St. Croix Improvement Company has about completed arrangements for the purchase of the power at Taylors Falls and expects to start work for the development of power there.

TWO HARBORS, MINN.—It is reported that the Crowley Electric Company, of Duluth, has secured the contract for the new machinery to be installed at the new village electric light station here. Probable cost, $16,000.

FORSYTH, MONT.—Crocket & Blum will install an electric light plant here.

FT. ASSINNIBOINE, MONT.—Plans are about to be prepared for a 300-hp electric light plant to be installed at this post.

HELENA, MONT.—The Butte & Anaconda Power Company has been incorporated, with a capital of $100,000, to build a power plant on the Missouri River, near Helena. It is hoped to develop 25,000-hp and it is the plan of the company to furnish power to Helena, Butte, Anaconda and all intermediate points.

HELENA, MONT.—J. F. Wegner, of Craig, has filed a notice of appropriation of 1,500,000 inches of the water of the Missouri River at Ox Bend canyon, near Hilger's. It is stated that he intends building a dam and erecting a generating station to furnish power for refining, smelting and other purposes.

OMAHA, NEB.—The city has contracted with the electric light company for special street illuminations for the Carnival of the Knights of Ak-Sar-Ben, to be held October 1 to 10. Two thousand five hundred dollars will be expended for this purpose. The Knights of Ak-Sar-Ben pride themselves in being the originators of electrically lighted floats and the annual carnival brings thousands of visitors to the city. The electric parade is a most gorgeous display and is unsurpassed. A floral decked automobile parade will be one of the attractions of the carnival week this year.

NIOBRARA, NEB.—New York parties are making plans and specifications for a water power electric plant at Niobrara. A franchise has been secured and the plans call for the construction of a wing dam to divert a portion of the river around the West side of Niobrara Island. A large amount of power is estimated to be available and will be transmitted long distances at high potential. The company back of the enterprise is known as the Niobrara River Power Company. Two other companies are making application to the State Irrigation Board for the use of the river at this same point.

TRENTON, N. J.—The Stuyvesant Company has been incorporated to construct and operate electric light plants, etc. Capital, $25,000. Incorporators: Saml. N. Lever, Rye, N. Y.; Albert C. Watson, N. Y. City, and H. A. Bingham, Oradell, N. J.

DANSVILLE, N. Y.—It is reported that the Dansville Gas & Electric Company has sold its plant to the Mill Creek Electric Light & Power Company and that the new company will install additional machinery.

CAMERON, TEX.—The Cameron Water, Power & Light Company has increased its capital stock from $50,000 to $100,000. It is understood that its plant is to be enlarged.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company has been incorporated, with a capital of $100,000. Incorporators: W. F. Ramsey, John K. Brydes and L. W. Chase.

WACO, TEX.—Bids are wanted Oct. 1 for electric lighting for a term of 5, 10 and 15 years, consisting of not less than 150 arc lamps of 9.6 amperes each, enclosed lamps 6.6 amperes each. Allan D. Sanford is Mayor.

BEAUMONT, TEX.—It is stated that the plant of the Beaumont Ice, Light & Refrigerator Company is about to be sold to Walter A. Myrick, of this city, and associates. If the deal is consummated the new owners will enlarge the electric light plant.

RICHMOND, VA.—Bids will be received Oct. 5 by Sol. L. Bloomberg, President Common Council, for a franchise to erect poles and run wires on the streets and alleys of the city, and to construct conduits or subways thereunder for the purpose of furnishing electric light and power.

MANCHESTER, VA.—The Committee of William and Mary College is reported to have rejected all bids received for installing a lighting plant in the college. The appropriation therefor is $5,000. Prof. Randolph, of the Virginia Polytechnic Institute, of Blacksburg, is reported to be a member of the committee.

OLYMPIA, WASH.—The Capitol Commission has awarded the contract for the power and lighting plant for the annex to Kilbourne, Clark & Company, of Seattle, for $10,500.

WALLA WALLA, WASH.—Saml. Storrow, engineer, Los Angeles, Cal., is preparing estimates for constructing a power plant on the Walla Walla River, in Walla Walla. Philadelphia parties are interested.

SEATTLE, WASH.—Contracts for furnishing material for installing a municipal power plant have been awarded as follows: To the Standard Underground Cable Company, of Pittsburg, Pa., wire and cables, at $29,856. To the Pelton Water Wheel Company, of San Francisco, Cal., contract for the water wheels and equipment, at $13,080. The contracts for insulators, generators, transformers and switchboards are still to be awarded.

RICHLAND CENTER, WIS.—A special election is to be held to vote on the question of issuing $20,000 electric light bonds.

ABBOTSFORD, WIS.—It is stated that C. W. Newberry, of Crookston, Minn., is preparing to install an electric light plant and a telephone system.

THE ELECTRIC RAILWAY.

COLLEGE HILL, ARK.—The College Hill Light & Traction Company has been chartered, with $195,000 capital; E. K. Smith, president; J. D. Sanderson, vice-president; E. J. Spencer, secretary; J. L. Chatfield, treasurer, and F. W. Offenhauser, assistant secretary.

PALO ALTO, CAL.—The Town Trustees have granted a franchise for an electric railway to J. F. Parkinson, of Palo Alto.

SANTA ROSA, CAL.—The Supervisors of Sonoma County have sold to Burke Corbett an electric franchise over the county roads leading from Petaluma to Sebastopol and then through Green Valley to Forestville.

LOS ANGELES, CAL.—The end of August marked a decided reduction in the construction force of the Pacific Electric Railway Company, as most of the interurban lines planned by the company for the present have been completed. The line to Whittier is all completed, except the laying of rails, which are late in arriving. The poles are up, the trolley wire is strung and the roadbed is ready for the steel.

SAN FRANCISCO, CAL.—Representatives of the Standard Oil Company propose to build an electric railway to connect Point Richmond with West Berkeley. The franchise, for which application has been made, calls for a road from San Pablo via Richmond, Barrett Station and Steege to West Berkeley, where connections can be made with other steam and electric lines for San Francisco. At Point Richmond the Pacific Coast Oil Company, which is a branch of the Standard Oil Company, has large petroleum refineries, the oil being pumped through a 300-mile pipe line from Bakersfield. Among the promoters of the enterprise are John C. Black, superintendent of construction of the refineries of the Pacific Coast Oil Company; E. A. Gowe, of the same company; C. Kinney, an electrical contractor, and L. D. Dimm, a manufacturer of lubricating oils. Some of the stock has already been paid in. The passenger business will be taken care of with high-class equipment, and there will also be a light freight and express service. The electric power for the operation of the road can be supplied from the Bay Counties transmission lines. The route will be through a growing manufacturing district along the bay shores of Contra Costa and Alameda counties.

APALACHICOLA, FLA.—The Apalachicola Street Railway Company has been granted a franchise by the City Council to build a street railway on various streets. The incorporators are H. W. Grady, John M. Fowler, Andrew L. Wing and Domingo Cattanetti.

TIFTON, GA.—The Tifton & Valdosta Railroad Company has given notice of application to the Secretary of State for incorporation. The road will run from Ocilla, in Irwin County, to Valdosta, in Lowndes County, a distance of 80 miles. It is also proposed to build an extension from Ocilla to Helena, in Wilcox County, connecting there with the Southern Railway. It is proposed to issue capital stock in the road to the amount of $10,000 per mile, or a total of $800,000 for the 80 miles. The general offices will be in Ocilla.

MARSEILLES, ILL.—The Illinois Valley Traction Company proposes to extend its line from Marseilles through to Morris and Joliet as soon as the road between LaSalle and Marseilles is completed and in operation.

JERSEYVILLE, ILL.—The Union Traction Company, of Jerseyville, has been incorporated with a capital stock of $2,500. The object of the corporation is to build an electric railway and furnish light and power. The incorporators are A. O. Auten, June M. Rhoades and Joseph W. Becker.

EAST ST. LOUIS, ILL.—Incorporation papers have been filed by the Municipal Traction Company, of East St. Louis. The new company proposes to build electric railways through the southeastern part of the city. The capital stock is $100,000. The officers of the company are C. O. McCasland, president; C. G. Derleth, vice-president; P. J. Soucy, treasurer, and D. H. Morrell, secretary.

GALESBURG, ILL.—The Galesburg, Monmouth & Rock Island Railway Company has awarded part of the contracts for constructing its proposed line between Galesburg, Monmouth and Rock Island, and construction work will be begun at once. About 70 miles of line are to be built. Fourteen motor cars and ten trailers will be operated. The general contractors are the Arbuckle-Ryan Company. The power station will be equipped with three 500-kw alternating-current direct-connected generators, Corliss engines and Sterling boilers. The officers of the company are G. F. Duncan, president; E. Woodman, secretary and treasurer; S. L. Nelson, manager and purchasing agent.

INDIANAPOLIS, IND.—A new company, organized to engage in building steam and electric railroads, has been incorporated with the Secretary of State. The title of the company is the Southern Construction & Equipment Company. The capital stock is $50,000. The directors are Frederick Cline, Frank N. Fitzgerald, William H. Lacey and others. The principal offices of the new company will be in this city.

PRINCETON, IND.—The Evansville & Princeton Traction Company has elected these officers: Joseph Hestone, president; Jonah Legrange, vice-president; William Sontag, general manager; E. J. Baldwin, secretary and general passenger and freight agent; Sam Weston, treasurer. The officers were elected as a board of directors. Perry Freeman, of Indianapolis, who is a heavy stockholder, is not represented. The capital stock is placed at $600,000, of which $50,000 has been sold. The road is completed from Princeton to Darmstadt, a suburb of Evansville.

BURLINGTON, IA.—Plans have been made for the construction of an interurban electric line from Burlington to Keosauqua. Corporate articles have been filed by the Burlington Interurban Company, with $200,000 capital stock. Carl Liepold is president, and J. W. Topping, secretary.

CEDAR RAPIDS, IA.—R. A. Wallace, A. T. Averhill, John T. Hamilton and John M. Redmond, well-known capitalists of this city, have made application to the City Council for a franchise permitting them to construct and operate an entirely new street car system in Cedar Rapids.

COUNCIL BLUFFS, IA.—The Council Bluffs, Tabor & Southern Railway Company is projecting an electric line to run from St. Joseph, Mo., to Rockport, Mo., thence north to Sidney, Ia., from Sidney to Tabor, from Tabor to Hillside, from Hillside to Glenwood, from Glenwood to Pacific Junction and from Pacific Junction to Council Bluffs.

BURLINGTON, IA.—The organization of the Burlington & Interurban Railway Company has been completed by the filing of articles of incorporation with the Secretary of State. The articles state that Burlington shall be the principal place of business, and that the authorized capital stock shall be $200,000. Carl Leopold, is president; W. W. Copeland, first vice-president; Charles Blaul, second vice-president; Charles Armknecht, treasurer; J. W. Topping, secretary, of Burlington, Ia.

OTTUMWA, IA.—The business men of this city are considering plans for the construction and operation of a railroad from Ottumwa, in a southwesterly direction through Moravia and Corydon to Allerton, to a point on the Southern Iowa division of the Rock Island in Wayne County. The name of the company will be Corydon, Moravia & Kansas City Railroad Company. The promoters have not yet decided whether to use steam or electricity as motive power. The line will be about 45 miles in length.

HUTCHINSON, KAN.—The Commercial Club has taken up the matter of an interurban electric railway from Hutchinson to Sterling, through Nickerson. President Charles Williams spoke of the proposition as being a feasible one.

FRANKFORT, KY.—The Frankfort Street Railway Company is preparing to extend the line to Versailles, and has had a new route surveyed.

PADUCAH, KY.—Ground for the power house and transfer station for the proposed electric railway between Paducah and Cairo, Ill., has been bought at Bandana, the central point on the proposed line. While full facts have never been given out regarding this line, it is known that the promoters are Paducah, Louisville and other outside capitalists. Mr. Pall, of Louisville, is interested.

MERIDIAN, MISS.—The Meridian Light & Railway Company has just completed an extension to the new Meridian Female College and the Meridian Male College. The company is about to rebuild its system entirely and has ordered new equipment. It is also building a new power house which will be provided with double equipment. These improvements will cost about $200,000. They will include the building of new electric light lines to the new college and the extension of the East End trolley line.

ST. LOUIS, MO.—The St. Louis & Valley Park Railroad Company has filed a petition in the St. Louis County Court, asking for a franchise to construct and operate an electric railway from St. Louis to Valley Park by way of Fenton.

JEFFERSON CITY, MO.—The Excelsior Springs & Missouri City Electric Railway Company has been granted a certificate of incorporation by the Secretary of State. The new company is capitalized at $200,000. The incorporators are John W. Creech, of Harrington, Kan.; Charles S. Curry, Sidney P. Allen, Elmore S. Truitt and Willard E. Winner, of Kansas City, and Maurice A. Wogan, of St. Joseph, Mo.

DECATUR, NEB.—The survey of the first section of the Omaha, Decatur & Northern Electric Railway Company from Decatur to Tekamah has been completed.

OMAHA, NEB.—The promoters of the Omaha, Lincoln and Beatrice Electric Railway say that construction of the road will be commenced within thirty days. The road will run through some of the choicest farm districts of Eastern Nebraska. An almost complete right of way for the entire road has been obtained.

TRENTON, N. J.—The Delaware Traction Company has received a franchise from the Ewing Township Committee, and will build from Trenton to Lambertville.

NEWARK, N. J.—It is announced that the Public Service Corporation had leased the South Orange and Maplewood Street Railway. It is said that $250,000 was paid for the line. The deal has been under consideration for some time.

HACKENSACK, N. J.—The Newark & Hackensack Traction Company which operates from Hackensack to Arlington, a distance of about 12 miles, is now owned by the New York & New Jersey Railroad & Ferry Company, whose tracks run from Fort Lee through Hackensack to Paterson, with a branch to Englewood.

MINEOLA, N. Y.—A mortgage for $1,000,000 has been entered to the Savings & Trust Company, of Cleveland, Ohio, by the Mineola, Hempstead & Freeport Traction Company, now the New York & Long Island Traction Company. The loan is for the purpose of extending the company's lines. The company now operates from Mineola to Freeport, and will soon have the extension from Rockville Centre to the New York City line finished. It also operates a line to Queens and contemplates lines to Babylon from Freeport; also routes on the north, central and southerly sections of the island into the city of New York, through traffic agreement with other lines or its own.

YOUNGSTOWN, OHIO.—Local interests are talking over the advisability of building an electric railway from Youngstown to Niles.

YOUNGSTOWN, OHIO.—The Youngstown, Park & Falls Street Railway Company has amended its charter so as to be permitted to construct and operate an electric railway from Central Square in Youngstown to Idora Park, in Youngstown Township, with lineal or lateral extensions, as the owners see fit.

NEWARK, OHIO.—Officers elected by the Newark, Martinsburg & Mount Vernon Traction Company are Edward H. Everett, president; Dr. J. F. Sprontz, vice-president; John Chilcote, treasurer; Frank Elliott, secretary; Edward Kibler, counsel. The company intends to build immediately. This road will complete the Cincinnati-Cleveland line.

GENEVA, OHIO.—Surveys have been made here for the electric railway between Geneva and Meadville. The line, as surveyed, comes into the county east of Pierpont and to Jefferson through the center of Denmark. The road will be over private right of way, except through the villages and Jefferson, where it will run the length of Jefferson Street, and on to Geneva.

COLUMBUS, OHIO.—The Southeastern Ohio Railway, Light & Power Company, of Zanesville, has been incorporated, with a capital stock of $10,000, by M. W. Hissey, E. R. Meyer, W. W. Harris, N. P. Shurtz and F. M. Ransbottom. The company proposes to build an electric railway from Zanesville through Roseville, Crooksville and Sayre to New Lexington, and to develop and sell electricity for light and power.

CLEVELAND, OHIO.—W. F. Stanley, vice-president of the Pennsylvania & Ohio Traction Company, is said to be interested in a plan to build an electric railway from Cleveland to Pittsburg. Mr. Stanley wants a private right of way into the heart of the city, although the proposed line will use the public streets for a short distance and will reach the Public Square. It is said that two routes have been suggested and surveyed. One of them goes to Akron, passes across to the Mahoning Valley, and then down to Pittsburg over some lines which are already in process of construction or which are projected in that territory. The other plan is to have the road built on a private right of way direct from Cleveland to the Mahoning Valley points.

STRATFORD, ONT.—The Council is prepared to negotiate with parties who would be willing to establish an electric railway here.

KANE, PA.—The Kane Electric Street Railway Company, Kane, Pa., has been incorporated with a capital stock of $24,000. President, Thomas S. Cunningham, Kane.

HARRISBURG, PA.—The control of the West Fairview & Marysville Electric Railway has passed into the hands of the Harrisburg & Mechanicsburg Railway. The stock amounts to $110,000 all told, and there is an equal amount of bonds. The acquisition of this line gives the Harrisburg & Mechanicsburg Railway control of the roads between Mechanicsburg, Camp Hill, White Hill, New Cumberland, Marysville and Harrisburg.

WESTERLY, R. I.—The directors of the Groton-Westerly Street Railway Company have decided to offer $200,000 of preferred stock to the public and to engage counsel to present the matter of public convenience and necessity before a judge of the Superior Court. Senator Hamilton, of Groton, president of the company, states that the company is not yet ready to consider contracts for the construction of the road. A committee consisting of President Hamilton, A. H. Chappell, Charles B. Noyes and B. F. Williams has been appointed to secure locations for a power plant and obtain the right of way where needed.

MEMPHIS, TENN.—The railroad committee of the City Council has decided to recommend that a franchise for a street railway be granted Fletcher R. Harris and associates, of St. Louis, for $150,000.

SAN ANTONIO, TEX.—The San Antonio Traction Company contemplates building a new branch line. The route of the proposed line is through the heart of the residence part of the city which is now without electric railway transportation facilities.

SALT LAKE CITY, UTAH.—The County Court has under consideration the petition of D. R. Roberts for an electric railway franchise. Mr. Roberts wants the right to build from Richmond to Wellsville, thus traversing the county from end to end. It is understood that he will next apply for a franchise in Logan City.

NEWPORT NEWS, VA.—The route of the projected Jamestown, Youngstown & Old Point Electric Railway has been determined upon. The line will have terminals at Newport News and Old Point.

RICHMOND, VA.—A charter has been granted to the Nelson & Albemarle Railway Company to build and operate an electric line from the soapstone quarry to the Southern Railway, a distance of six miles to eight miles. The capital stock is $250,000. The incorporators are J. W. Foster, H. L. Lane, D. J. Carroll, F. V. Elsom, D. H. Pitts, J. G. Hopkins and George W. Bostwick.

TACOMA, WASH.—The Tacoma Railway & Power Company contemplates building an interurban line to Sumner and Puyallup.

SPOKANE, WASH.—A 60-mile electric railway to run from Spokane via Newman Lake to Rathdrum, then looping back to Cœur d'Alene City and Liberty Lake, with a spur to Steamboat Landing, on the Pend d'Oreille River, and a branch to Harrison, is proposed. Eastern capital is behind the enterprise. James Edwards, a civil engineer, formerly with the Northern Pacific, is preparing data to be submitted to the promoters.

WHEELING, W. VA.—It is stated that in the near future the Wheeling & Elm Grove Traction Company will build another power house.

MILTON JUNCTION, WIS.—Three hundred citizens have petitioned the Rockford, Beloit & Janesville Railroad Company to extend its road to Milton Junction.

NEW INDUSTRIAL COMPANIES.

THE WOLD ELECTRIC MOTOR COMPANY has been incorporated in New York City to manufacture electric motors; capital, $50,000. Incorporators: David Wold, Louis Nashley, Otto C. Britsch, all New York City.

THE ERNEST J. WILLIS COMPANY, of Manhattan Borough, New York City, has been incorporated to deal in automobiles and electric and other vehicles; capital $75,000. Directors: Ernest J. Willis, Caroline M. Willis, Manhattan; William W. Myers, Brooklyn.

THE BETTINI PHONOGRAPH COMPANY, Manhattan Borough, New York City, has been incorporated to continue the business of G. Bettini; capital $20,000. Directors: Gianni Bettini, Paris, France; William A. Abbott, Stamford, Conn.; Daniel P. Mitchell, New York.

THE J. WARREN GAY ELECTRIC COMPANY, of New London, Conn., has been incorporated with a capital stock of $2,400. It is organized for the sale of electrical supplies, the construction, repairing and installing of electrical machinery and equipment and the business of lock-smithing.

LEGAL.

INJURIES FROM POLES.—The full bench of the supreme court, Judge Lathrop dissenting, has decided in the case of Jeremiah Riley vs. The New England Telephone & Telegraph Company, that corporations having poles in the street are liable for injuries caused by their existence provided the injured person exercises due care. The fact that the companies are entitled by reason of municipal franchises to maintain such poles does not exempt them from liability.

TELEPHONE LINES IN FREMONT, NEB.—At Fremont, Neb., on August 27, Judge Grimison rendered a decision in the case of Nebraska Telephone Company vs. the City of Fremont, adverse to the city. The city had attempted to stop the Nebraska (Bell) Company from further extension of its lines in the city, contending that the company had no franchise. The telephone company secured a temporary injunction and by this decision the injunction has been made perpetual. The company tried to show in the trial that it had succeeded to the plant and franchise of the old Fremont Telephone Company. The decision of the court is chiefly on the grounds that the company had been allowed use of the streets without objection for eighteen years. An appeal to the Supreme Court will be made by the city.

BREAKING OF TELEPHONE CROSS ARM.—In an appeal to the Court of Appeals of Maryland, in Maryland Tel. & Tel. Co. vs. Cloman, where in the first suit the plaintiff, an experienced lineman, was injured by the breaking of a cross arm at the top of a telephone pole, the lower court's decision in favor of the plaintiff was reversed. The arm broke while plaintiff was straining certain wires upon it, by reason of the existence of a knot in the arm near where one of the pins inserted to hold the insulators was placed. The defect was obscured by paint and could not have been discovered by ordinary inspection. The arm was of the kind ordinarily used, and purchased by defendant after being painted. It was held by the Court of Appeals that such facts were insufficient to establish negligence of defendant in furnishing such defective arm for use, and that the court's refusal to direct a verdict for defendant was therefore an error. In another appeal case of the same company, in an action for injuries to plaintiff by tripping over a telephone wire lying concealed in the grass in the street, the evidence was reviewed and was held to be insufficient to justify a finding that defendants owned or were in control of the wire at the time of the accident.

PERSONAL.

MR. JOHN H. BARKER, for several years with H. B. Coho & Co., has accepted the position of General Sales Agent for the Mechanical Appliance Company for all territory east of Pittsburg and Buffalo.

MR. C. O. BAKER, JR., the well-known platinum merchant, has just returned from a summer vacation in Europe, greatly benefited by the change. He met many old electrical friends while on the other side.

MR. SETH H. DYER has resigned his position of electrical engineer with the Guanajuato Consolidated Mining & Milling Company, to accept the managership of the Alumbrado Electrico (electric lighting company) of Morelia, Mexico.

MR. W. S. BARSTOW, the consulting electrical engineer, has removed his offices in New York City to suite 1100-1103 56 Pine Street. He is about to make a trip to the Pacific slope, where he has some important consultation work on hand.

PROF. C. P. MATHEWS will not resume his duties at Purdue University owing to trouble with his eyes. The injury is largely the result of the work of Prof. Mathews in arc light testing, the results of which appeared in the admirable reports on this subject made to the National Electric Light Association.

MR. CALVIN W. RICE, who went abroad a few months ago broken in health has just returned home from Europe in excellent trim, greatly benefited by the change. He pushed his travels as far as Venice, and while in England had the honor of being entertained by Lord Kelvin and Andrew Carnegie.

MR. S. HENRY BLAKE has recently been made engineer of arc lighting for the General Incandescent Arc Light Company, with headquarters at its works, Pittsfield, Mass., succeeding Mr. J. Henry Hallberg, resigned, whose assistant he has been for over four years. His most recent work has been the superintendence of the installation of 4,500 4 ampere G. I. lamps in the city of Cincinnati, Ohio.

MR. GEORGE F. DURANT and his pioneer work in the development of telephony in St. Louis come in for appreciative treatment in the *Republic* of that city. It was there that the old Law system received recognition and was long used. Mr. Durant was and is the general manager of the Bell Telephone Company of Missouri, formed as far back as 1879 with a capital of $400,000. In 1878 it had 15 subscribers. To-day it has 15,000.

MR. L. F. MAHLER, formerly district manager of the DeLaval Steam Turbine Company, at Chicago, has assumed a like position with the Bullock Electric Manufacturing Company, with offices at 1505 Chemical Building, St.

Louis. Mr. Mahler has under his supervision the following territory: The southern half of Illinois, Missouri, Kansas, Arkansas, Indian Territory, Oklahoma, Nebraska, the Dakotas, and the northern half of Texas.

THORBURN-PAINTER.—The many friends in the electrical field of the late Uriah H. Painter, of Washington, who was prominent in many of the early electric light and motor developments, are interested to note the marriage of his daughter, Miss Alice Elise Hunt Painter to Mr. D. Scott Thorburn, son of Sir Walter Thorburn, M. P., of Peebles, Scotland. The wedding took place last week at Elberon, N. J., and was a very fashionable affair.

MR. WILLIAM HENGERER, president of the William Hengerer Company, which is building the largest department store in Buffalo and one of the largest in the world, arrived from Europe last week on the *Deutschland*, and this week is in New York getting estimates on his plans for the complete electrical plant and equipment for the new Buffalo store. The plans for the electrical plant were furnished by a local electrical engineering firm, and the contracts will be placed for delivery in time for installing during January next.

SIR HIRAM MAXIM.—A cable dispatch from London says: Sir Hiram Maxim stated at a meeting of the Maxim Electrical & Engineering Company of London that he will shortly announce an important invention which will bring forth more money than anything he has ever done, not excepting his automatic gun. He added that he was putting thousands of pounds into the invention, the character of which he will not divulge until all the patents are secured. The president of the company announced that the company had the patent for a new boiler, made entirely of steel, which was more economical in working and cheaper than anything of the kind now on the market.

PROF. BYRON BRIGGS BRACKETT, A.M., PH.D., has been appointed to the chair of Physics and Electrical Engineering at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y. Prof. Brackett is a graduate of Syracuse University and received his doctor's degree from Johns Hopkins University. His teaching experience has been in Dickinson Seminary, Williamsport, Pa.; Adelphi Academy, Brooklyn, N. Y.; Eastern High School, Washington, D. C.; Electrical Engineering Laboratory, Johns Hopkins University, Baltimore, Md.; Union College, Schenectady, N. Y.; Rutgers College, New Brunswick, N. J., with which institution he was last connected previous to appointment to the Clarkson School of Technology. His practical electrical engineering experience comprises the inspection and testing of all the cable manufactured for the U. S. Army during the Spanish-American war by the General Electric Company, at Schenectady, N. Y.; a year's work with the late Prof. Henry A. Rowland, of Johns Hopkins University in the development of the Rowland Printing Telegraph, with considerable experience in commercial electrical testing at various times.

EDUCATIONAL.

OMAHA Y. M. C. A.—The Educational Committee of the Omaha Young Men's Christian Association has issued an announcement for its night school for men which will open October 5 and be conducted through six months. Twenty-three subjects and twenty-one instructors are announced. Mechanical Drawing, Architectural Drawing, Steam Engineering, Electricity and Telegraphy will be included in the course of studies. Mr. A. J. Collett, draftsman at the Union Pacific railway shops at Omaha, will instrust the classes in drawing; Mr. A. H. Fetters, assistant mechanical engineer at the Union Pacific shops, will be instructor in steam engineering; Mr. T. H. McGrath, chief dispatcher for the F. E. & M. V. Ry. Co., the class in telegraphy, and Mr. John Hay Kuhns, electricity.

Trade Notes.

NERNST LAMP.—The New York sales offices of the Nernst Lamp Company have recently been removed from the Equitable Building to the new Hanover Bank Building, No. 11 Pine Street.

STANLEY WATTMETER.—The September bulletin of the Stanley Instrument Company, of Great Barrington, Mass., is devoted to the Stanley recording wattmeter for alternating current circuits, which is illustrated and described in minute detail.

WM. ROCHE, manufacturer of the New Standard dry battery, has recently been compelled to enlarge his plant owing to the constantly increasing demand for his product. Mr. Roche reports the most successful season he has experienced since his start in business.

"MICHIGAN WHITE CEDAR," a story in two chapters, is the title of a booklet that the Maltby Lumber Company, of Bay City, Mich., cedar dealers, is sending out to all its customers. Considerable information and some rather instructive pictures are contained in the folder, which it will be glad to send to any one interested in the purchase of cedar ties or poles.

SPRINGS.—The Wallace Barnes Company, Bristol, Conn., has recently issued a new catalogue of the very extensive line of small springs manufactured by it. The list includes springs for motors, phonographs, clocks, etc., and spiral, hinged, tapered and many other forms. Some very clear illustrations show the many kinds of springs produced by this company. The catalogue is accompanied by a new stock sheet.

THE H. T. PAISTE COMPANY, of 3101 Ludlow Street, Philadelphia, has about completed the general distribution of its new catalogue No. 10. Therein it has listed besides its line of general supplies, all of its most recent specialties, exclusively "P-K." It particularly desires that none of the trade be without a copy of its catalogue, which it considers practically a "Directory of Electrical Supplies." The copies, of course, are free and a postal will bring one.

INTERCOMMUNICATING TELEPHONES.—The Stromberg-Carlson Telephone Manufacturing Company has just issued a neatly gotten-up pamphlet on its central energy intercommunicating telephone systems. It includes some fine illustrations of the apparatus comprising these systems, and tells some of their features and advantages. On the front cover is the significant statement that "With a telephone at your right hand your department's at your command."

WAGNER POLYPHASE WATTMETER.—The Wagner Electric Mfg. Company, of St. Louis, Mo., is placing on the market a polyphase wattmeter in two forms—portable and switchboard. The same company is also manufacturing a portable alternating current ammeter, which is particularly applicable for determining the loads carried by transformers. It is supplied with a series transformer having leads 30 feet long, and so arranged that the small transformer can be slipped over the lighting transformer leads without disturbing them in any way.

STURGESS WATER WHEEL GOVERNORS.—The Sturgess Governor Engineering Company, of West Troy, N. Y., has just issued a new edition of its catalogue on water wheel governors, which have lately been brought to the attention of the public through the columns of the technical press. All the movements in this governor are produced by fluid pressure, which may be either oil or water, the former for low heads and the latter for heads of more than 100 feet. The pamphlet is well illustrated and there is a great amount of interesting data in it.

THE AVA CHEMICAL COMPANY.—Announcement has been made at the business office of the Ava Chemical Company, of New York, that arrangements will be made with local druggists for the sale of certain of the products of the Chemical Company at once. Preparations for the opening of a large number of laboratories have been steadily in progress and within ten days the first outside of New York will be opened. Others will be opened thereafter as soon as possible. The factory to be built by the Ava Chemical Company at Niagara Falls in the near future will be among the earliest completed.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, announces that owing to the constant growth of the business during the past ten years it has found it advisable to increase its cash capital and divide its business into two parts. That portion of the business relating to electrical supplies and its good will and stock of goods has been sold to the Wesco Supply Company. The other part of the business, that of railway supplies and the building of electric light plants and electric railways, will be retained and will hereafter restrict itself to this branch of the business. Note of this change has already been made in these columns.

ELECTRIC APPLIANCE COMPANY.—The general supply catalogue No. 20 is just from the press of the Electric Appliance Company, Chicago. This catalogue is a most attractive one in appearance and in completeness and arrangement is fully up to the standard of others issued by this hustling house. It lists many new articles never before shown in a supply catalogue and all out-of-date items have been eliminated. This large volume with the loose leaf discount book accompanying it should be in the hands of every electrical buyer. The company will take pleasure in sending a copy by prepaid express to anyone in the trade who has been overlooked in the distribution.

RAILWAY SHOP EQUIPMENT.—The Crocker-Wheeler Company, of Ampere, N. J., has just issued in handsome pamphlet form of 32 quarto pages and cover the illustrated description of the new shops at Collinwood, Ohio, of the Lake Shore & Michigan Southern Railway. In these shops there is a very complete Crocker-Wheeler lighting and power plant of about 1,200-hp. The motor equipment is large. Individual direct-connected motors were installed on about three-fourths of the machine tools, and the others were put into seventeen groups, each with its line shaft driven by a separate constant speed motor. The Crocker-Wheeler system of multiple-voltage speed control is used. The pamphlet is full of interesting power data as furnished from this ideal plant.

WOOLLEY FOUNDRY & MACHINE WORKS, Anderson, Ind., issue a neat descriptive and illustrative catalogue in regard to their Burger gas and gasoline engines. These are of simple, durable form. The igniter is a removable plug fitted to a hole communicating to the upper part of the cylinder where the richest gases locate, thus ensuring perfect ignition. The plug is seated at its inner end, and current is derived usually from a magneto on the engine bed. One type of the engine, the Hit or Miss, has a centrifugal governor, and the automatic type is equipped with the Rites inertia governor of the single weight type. All the Burger engines are equipped with a pump attached to the engine bed, operated by the engine, with which the gasoline is drawn from the distant storage tank. The indicator cards shown are excellent.

PIPE JOINT COMPOUND.—In a neat booklet issued by the Joseph Dixon Crucible Company is told an interesting little story about an attempt to remove a plug from a steam pipe which refused to budge because Dixon's graphite pipe joint compound had not been used, the old-fashioned red lead compound having been applied instead. Dixon's compound, it is stated, makes joints absolutely tight, and they can be easily separated at any time. This graphite compound is highly recommended for use on surfaces that are in contact, and where it is necessary that they shall not stick. Besides that the compound, it is stated, prevents rusting. Gaskets rubbed with the compound can be easily removed and used over again. Every one interested in steam fitting and engineering can get a copy of this booklet by addressing the company at Jersey City, N. J.

ELECTROMAGNETS.—The Varley Duplex Magnet Company, Providence, R. I., has issued a very interesting catalogue which contains illustrations of many of the different varieties of electromagnets manufactured by it. Among the magnets shown are spark coils, solenoids, medical coils, switchboard magnets, field magnets, ringer magnets, induction coils for telephones, fan motor coils, etc. An interesting illustration is that showing the automatic winding machines for the manufacture of telephone magnets made of either bare or insulated wire. These machines have a capacity of 50,000 per day. Views of other machines are shown. Besides the illustrations above referred to there are a couple of curves showing the relations of ampere-turns and air gap to the pulling force. The company manufactures magnets for every purpose to which electromagnets are applied. The catalogue is neatly designed and is printed in black and orange.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 8, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

737,997. ELECTRIC CONDUCTOR MOLDING; Sidney M. Burk, Philadelphia, Pa. App. filed April 25, 1903. The grooves in the molding are made undercut or dovetailed, so that when the wire is placed therein in a zigzag direction, it will engage with the sides of the groove and be held therein even when the molding is applied to the ceiling. (Dated Sept. 1.)

738,167. AUTOMOBILE CONTROLLING MECHANISM; George H. Day, Hartford, Conn. App. filed Jan. 16, 1903. A locking device for the brake co-operates with a cut-out switch whereby the locking of the brake in its applied position prevents the application of power to the motor.

738,173. MOTOR CONTROLLING MECHANISM; Charles E. Ennes, Chicago, Ill. App. filed Sept. 22, 1902. A fluid medium under the control of electrically operated mechanism is used to actuate the controlling switches.

738,188. SECONDARY BATTERY; George E. Hatch, Quincy, Mass. App. filed Feb. 13, 1899. (See page 482.)

738,294. LAMP SOCKET; Walter A. Church, Binghamton, N. Y. App. filed Oct. 18, 1902. The parts of the socket are of peculiar shape and housed within a solid block of insulating material made in two parts.

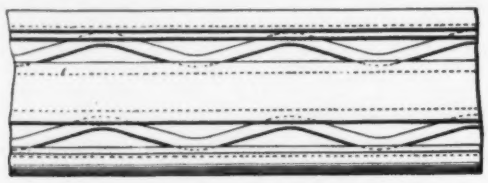
738,302. SIGNAL TRANSMITTING SYSTEM; Edward B. Ellicott, Chicago, Ill. App filed Jan. 13, 1902. A master circuit contains a transmitting key and a series of magnets, each of which operates a key in a signal circuit. By a suitable device any of the signal magnets can be made inoperative.

738,305. TROLLEY FOR ELECTRIC RAILWAYS HAVING OVERHEAD WIRES FOR SUPPLY OF CURRENT; Amedee Fayol, Bordeaux, France. App. filed June 28, 1902. A fork is pivoted near the trolley wheel and can be thrown upward by pulling on the rope, to help guide the wire into the groove of the wheel.

738,313. PROCESS OF PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES AND PRODUCTS THEREOF; Oliver P. Fritchle, Denver, Colo. App. filed Jan. 7, 1903. (See page 482.)

738,314. APPARATUS FOR PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES; Oliver P. Fritchle, Denver, Colo. App. filed Jan. 7, 1903. (See page 482.)

738,331. ORE SEPARATOR; Conrad F. Lancaster, East Liverpool, Ohio. App. filed Oct. 20, 1902. A device for removing iron particles from fire



737,997.—Electric Conductor Molding.

clay. The pulverized clay is passed between magnetized corrugated plates and the metal particles adhere in the re-entrant angles of the plates.

738,333. CONTACT MAKER FOR ELECTRICAL SIGNS; Conrad F. Lancaster, East Liverpool, Ohio. App. filed Oct. 20, 1902. Details.

738,392. RHEOSTAT; Walter V. Ash, Perth Amboy, N. J. App. filed Jan. 2, 1903. A rheostat containing controllable resistances for both the armature and field of a shunt motor.

738,393. APPARATUS FOR REMOTE CONTROL OF ELECTRIC MOTORS; Walter V. Ash, Perth Amboy, N. J. App. filed Jan. 2, 1903. Solenoids arranged each side of the controlling arm can be energized from a distance to move the arm either to the right or left.

738,426. ELECTRIC ARC LAMP; Charles E. Foster, Streatham, England. App. filed July 5, 1902. Details.

738,427. PROCESS OF PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES AND PRODUCT THEREOF; Oliver P. Fritchle, Denver, Colo. App. filed March 18, 1903. (See page 482.)

738,437. APPARATUS FOR CHANGING CHARACTER OF ELECTRIC CURRENTS; Noah S. Harter, Cherokee, Ia. App. filed May 27, 1903. Details of a pole changing switch for sending rapid changes of polarity or pulsations from a continuous current generator.

738,442. BOILER ALARM; William C. Heitkamp, Pleasantridge, Ohio. App. filed June 23, 1902. A float in the boiler carries a rack engaging with a gear wheel which moves an external indicator to show the level of the water. The index of the indicator closes an alarm circuit at predetermined points in its travel.

738,468. LOCOMOTIVE ENGINEER'S ALARM; Edward McClintock, Merrian Park, Minn. App. filed Feb. 5, 1903. Signal rails are arranged in blocks along the main rails and co-operate with special trucks carried by the trains, so as to afford intercommunication between signal mechanisms on the trains.

738,478. BRUSH FOR ELECTRIC MACHINES; Cornelius R. Phillips, Philadelphia, Pa. App. filed June 12, 1903. A carbon brush having chambers for a lubricating material, the latter percolating through the pores of the material to the working face of the brush.

738,480. REGISTERING APPARATUS; Anton Pollak, Budapest, Austria-Hungary. App. filed July 2, 1902. A ray of light projected to the indicator from the original source of light is projected from a moving point so that the movements of the ray from the indicator may be recorded in successive lines like an ordinary written page. The apparatus is used in rapid telegraphy where the record is made on a sensitized strip.

738,489. ELECTRIC SIGN; Bert E. Salisbury, Syracuse, N. Y. App. filed Dec. 30, 1902. The receptacles are cylindrical and occupy circular holes in the face of the sign, the back of each receptacle having binding screws so that the two wires of the circuit can be readily attached.

738,519. ELECTRIC SWITCHBOARD; William F. Bossert, Utica, N. Y. App. filed July 17, 1903. The cross-connecting bars have sockets adapted to receive an ordinary screw-threaded fuse plug which fits therein to afford a low resistance contact.

738,525. TELEGRAPHIC TRANSMITTER; Joseph P. Conway, Los Angeles, Cal. App. filed Aug. 15, 1902. A series of key levers each of which carries notches that are arranged to make and break the circuit in accordance with Morse characters when the lever is pressed by the finger.

738,545. CORD TIP; William Kaisling, Chicago, Ill. App. filed June 6, 1902. A metal sleeve clamps the covering of the wire and is then inserted in a tubular portion of the tip where it is held by solder.

738,594. AUTOMATIC SWITCH HANDLE FOR ELECTRICAL TOOLS; James I. Ayer, Cambridge, Mass. App. filed April 14, 1903. A quick acting switch in the handle of a soldering iron or similar tool, so constructed that the operator is not compelled to retain a tight grip of the handle to prevent the switch from opening.

738,601. CROSS FOR CHURCH TOWERS; Joseph A. Blenke, Covington, Ky. App. filed May 16, 1903. The lamps which illuminate the cross are mounted on endless belts so that an impaired lamp can be moved from a remote part of the cross to the base portion and replaced; thus avoiding the necessity of reaching or climbing to the extremities of the structure.

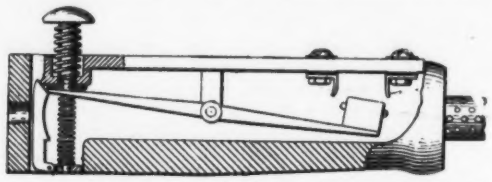
738,602. TROLLEY STAND; John J. Bouchard and William F. Ensor, Bradford, Pa. App. filed Dec. 18, 1902. Details of the horizontal pivot of the pole to avoid friction and exclude dust and dirt.

738,607. ELECTRIC WATER HEATER; John W. Ewart, Wendover, England. App. filed Jan. 3, 1903. Pipes through which the water leads have a heating resistance wrapped around them and are located in a vacuum chamber to enable the temperature of the wires to be raised higher than could be done if the wires were exposed to the air.

738,624. ELECTRIC IGNITING DEVICE; Harry B. McNulty, Washington, D. C. App. filed Feb. 13, 1903. Details.

738,648. INCANDESCENT LAMP SOCKET; Joseph L. Yost and Owen E. Kenney, Toledo, Ohio. App. filed June 12, 1903. Details.

738,649. CONTACT SHOE FOR ELECTRIC RAILWAYS; Walter D.



738,594.—Automatic Switch Handle for Electrical Tools.

Young, Baltimore, Md. App. filed Jan. 21, 1903. A mounting for the shoe enabling it to constantly maintain a square contact with a third rail.

738,651. PREVENTING LEAKAGE OF CURRENT TO STUDS IN SURFACE CONTACT SYSTEMS OF ELECTRIC TRACTION; Benjamin H. Bedell, London, England. App. filed March 17, 1903. A conducting shield is interposed between the live rail or wire and the surface stud, so that any leakage current will be grounded before it reaches the stud.

738,676. TROLLEY RETRACTOR; Richard H. Ham, Stockport, N. Y. App. filed Jan. 16, 1903. Details.

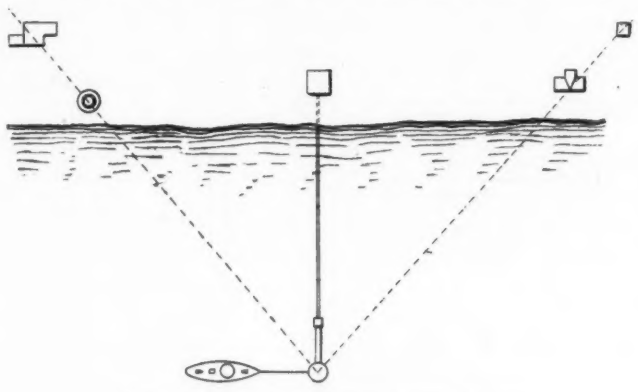
738,688. FLOOR BOX; Hubert Krantz, Brooklyn, N. Y. App. filed May 14, 1903. The box is set into the floor below the floor level and a water-tight cover screws into place until it is flush with the level of the floor, a plug carrying the terminals fitting a central opening in the cover.

738,717. LAMP SOCKET; Leonard Erikson, Malden, Mass. App. filed July 2, 1902. An elongated block having a lamp socket at each end and adapted to fit into and engage with a curved elongated reflector.

738,718 and 738,719. GALVANIC CELL; Lothar Fiedler, London, England. App. filed Dec. 22, 1902. (See page 482.)

738,721. THIRD RAIL SYSTEM; John H. Hughes, Greenwich, Conn. App. filed April 30, 1903. The third rail is supported on angle brackets which are clamped between, but insulated from, two inverted T-rails.

738,725. SYSTEM OF SUBMARINE COMMUNICATION; Simon Lake, Bridgeport, Conn. App. filed June 23, 1902. A system of wiring laid upon the bed of a body of water and connecting together various stations



738,725.—System of Submarine Communication.

under water and on land and provided with means whereby a submarine vessel can make connections at a station and communicate with the other stations.

738,734. ELECTRIC HEATER OR RADIATOR; Edward G. Rivers, Richmond, England. App. filed Nov. 21, 1902. The heater units consists of enamelled metal plates having powdered and compressed carbon confined between them.

12,151. APPARATUS FOR AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; John S. Stone, Boston, Mass. App. filed Aug. 18, 1903. This patent and the one following relates to a method of developing high-frequency simple harmonic electromagnetic signal waves consisting in producing oscillations of corresponding frequency in a primary circuit and causing the same to be inductively reproduced at an increased amplitude in the elevated conductor.

12,152. METHOD OF AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; John S. Stone, Boston, Mass. App. filed Aug. 18, 1903. See preceding patent.